AMERICAN ENGINEER AND RAILROAD JOURNAL.

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CONTENTS.

WIDE FIREBOX CONSOLIDATION LOCOMOTIVES.

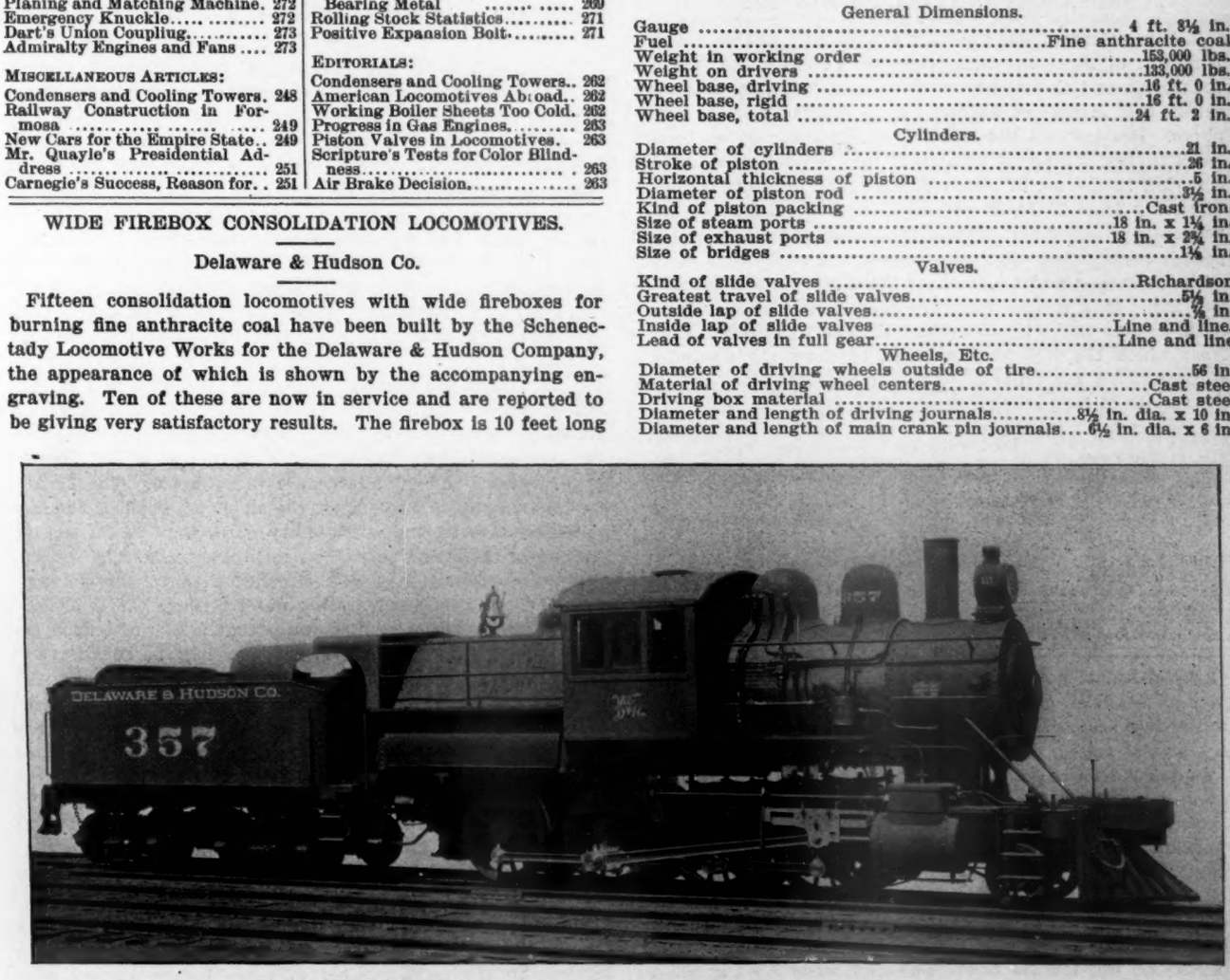
Delaware & Hudson Co.

Fifteen consolidation locomotives with wide fireboxes for burning fine anthracite coal have been built by the Schenectady Locomotive Works for the Delaware & Hudson Company, the appearance of which is shown by the accompanying engraving. Ten of these are now in service and are reported to be giving very satisfactory results. The firebox is 10 feet long and 8 ft. 6 in. wide, giving a grate area of 90 square feet. This is another example of the tendency toward the use of very large grates for the purpose of burning fine anthracite coal, which may be bought at low prices. The practice of the New York, Ontario & Western in this regard, whereby Mr. West has reduced the cost of locomotive fuel to one-half of the corresponding cost in 1888, is interesting and suggestive of the possibilities for savings where the low grades of fuel are available. Mr. West's practice was described in our issue of March, 1899, page 75. The recent paper by Mr. S. M. Vauclain before the New York Railroad Club and other equally well founded opinions seem to indicate a tendency toward more favorable consideration of wide fireboxes, especially where culm may be used.

The heating surface is 2,564 square feet, 201 square feet being in the firebox. The cylinders are 21 by 26 inches and the weight on driving wheels is 133,000 pounds. The driving wheels are 56 inches in diameter. The boiler is 66 inches in diameter and cylindrical in front of the firebox, which is stayed with vertical stays. The smoke box is short, with just enough room for the cinder pocket in front of the saddle castings.

An unusual arrangement has been adopted for the injector piping, the injectors being both on the right hand side of the engine and the piping is entirely outside of the cab. The air pump and injector steam connections enter the dome by means of angle valves, instead of the usual way of connecting them to a steam box inside of the cab. It is worthy of passing notice that the eccentric rods of this design are very short and that the rocker shaft is placed in front of the main driving wheels. The following table presents the chief dimensions:

General Dimensions.	
Gauge	4 ft. 8½ in.
Fuel	Fine anthracite coal
Weight in working order	153,000 lbs.
Weight on drivers	133,000 lbs.
Wheel base, driving	16 ft. 0 in.
Wheel base, rigid	16 ft. 0 in.
Wheel base, total	24 ft. 2 in.
Cylinders.	
Diameter of cylinders	21 in.
Stroke of piston	26 in.
Horizontal thickness of piston	5 in.
Diameter of piston rod	3½ in.
Kind of piston packing	Cast iron.
Size of steam ports	18 in. x 1¼ in.
Size of exhaust ports	18 in. x 2¾ in.
Size of bridges	1⅛ in.
Valves.	
Kind of slide valves	Richardson
Greatest travel of slide valves	5½ in.
Outside lap of slide valves	⅞ in.
Inside lap of slide valves	Line and line.
Lead of valves in full gear	Line and line
Wheels, Etc.	
Diameter of driving wheels outside of tire	56 in.
Material of driving wheel centers	Cast steel
Driving box material	Cast steel
Diameter and length of driving journals	8½ in. dia. x 10 in.
Diameter and length of main crank pin journals	6½ in. dia. x 6 in.



Consolidation Locomotive with Wide Firebox—Delaware & Hudson Co.

Diameter and length of side rod crank pin journals—Main side, 7 in. x 5¼ in.; F. & B., 5 in. x 3¾ in.; int., 5½ in. dia. x 5 in.	
Engine truck, kind	2-wheel swing bolster
Engine truck, journals	6 in. dia. x 10 in.
Diameter of engine truck wheels	30 in.
Kind of engine truck wheels	Steel tired spoke.
Boiler.	
Style	Straight with wide firebox
Outside diameter of first ring	66⅛ in.
Working pressure	180 lbs.
Material of barrel and outside of firebox	Carbon steel
Thickness of plates in barrel and outside of firebox,	⅝ in., 11/16 in., ½ in., 7/16 in.
Firebox, length	120 in.

Firebox, width	102 in.
Firebox, depth	53½ in. B., 63 in. F.
Firebox, material	Carbon steel
Firebox plates, thickness, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube sheet, 9/16 in.	
Firebox watre space	3½ in. front, 3 in. sides, 3½ in. back
Firebox crown staying	Radial stays, 1⅛ in. diameter
Firebox stay bolts	⅞ in. x 1 in. diameter
Tubes, number of	310
Tubes, diameter	2 in.
Tubes, length over tube sheets	14 ft. 0 in.
Heating surface, tubes	2,257.98 sq. in.
Heating surface, water tubes	104.72 sq. ft.
Heating surface, firebox	201.67 sq. ft.
Heating surface, total	2,564.37 sq. ft.
Grate surface	90.05 sq. ft.
Grate, style	Water tubes, dead bars and drop bars
Ash pan, style	Hopper dampers, front and back
Exhaust pipes	Double high
Exhaust nozzles	3¼ in., 3⅜ in., 3½ in. dia
Smokestack, inside diameter	16 in
Smokestack, top above rail	14 ft. 11⅛ in.
Boiler supplied by	2 injectors, Nathan & Co. monitor No. 10 Tender.
Wheels, number of	8
Wheels, diameter	33 in.
Journals, diameter and length	5 in. dia. x 9 in.
Wheel base	15 ft. 8 in.
Tender frame	10 in. steel channel
Water capacity	5,000 U. S. gallons
Coal capacity	7 tons
Total Wheel base of engine and tender	50 ft. 10¾ in.

CONDENSERS AND COOLING TOWERS.

Exhaust steam under ordinary conditions contains about 90 per cent. of the heat units originally put into the steam in the boiler, and this alone constitutes an excellent reason for utilizing it instead of allowing it to escape into the atmosphere. Besides this the steam is easily made to do further work in the engine by passing it into a condenser, making a saving in the use of steam possible and affording a means of saving from 15 to 20 per cent. in the coal burned. The vacuum on the exhaust side of the piston adds from 10 to 12 pounds to the mean effective pressure, and more work is done with the same amount of fuel, or the same work is done with less fuel. In a paper before the American Institute of Electrical Engineers the late Dr. Chas. E. Emery presented a table from which the following is taken to show the advantages of condensing for different types of engines; this embodies the results of long study and experimenting:

Type of Engine. Name.	Feed Water per Indicated Horse Power Per Hour. Non-Condensing. Probable Limits.	Non-Condensing. Assumed for Comparison.	Condensing. Probable Limits.	Condensing. Assumed for Comparison.	Per cent. gained by condensing.
	Lbs.	Lbs.	Lbs.	Lbs.	
Simple High Speed.....	35 to 26	33	25 to 19	22	33
Simple Low Speed.	32 to 24	29	24 to 18	20	31
Compound High Speed..	30 to 22	26	24 to 16	20	23
Compound Low Speed..	.....	..	20 to 12¾	18	25
Triple High Speed.....	27 to 21	24	23 to 14	17	29
Triple Low Speed..	.....	....	18 to 12¾	16	...

The additional power shown in the increased mean effective pressure is not all clear gain, because some additional work is involved in connection with the condenser, but the gain in economy, as stated, may be expected.

While condensers are as old as the steam engine, until quite recently their attachment has been considered only in connection with plants which were located near sources of an abundant water supply, but recent practice has shown that by comparatively simple means of cooling the water a small amount of water may be used sometimes even to better advantage than a large or even inexhaustible supply, and at present very few steam plants used in connection with electric power stations do not include condensers and water cooling appliances. These are so simple and easy to construct that we wish to direct attention to their advantages in connection with every steam plant that is so located as to give a high or even moderate price for coal.

Whatever form of condenser is employed a cooling system may be considered as generally necessary. Among the different ways of cooling condensing water the following seem to be the most important: (1) Reservoirs of comparatively large area, which are used with advantage where the necessary ground space is available; (2) pools, in which the water is circulated and caused to cool by surface evaporation; these require somewhat less space than reservoirs, but require circulation of the water; (3) sprays or fountains which deliver the water in finely divided state whereby it is cooled in contact with the air; (4) cooling towers, which are fitted with partitions, nettings, short pieces of tile or other means for greatly increasing the cooling surface, and these are usually fitted with fans for the circulation of air, the water is carried to the top of the tower and allowed to drop over the surfaces; (5) series of pans so arranged that the water will drip from one to the next one below it are arranged in framework supported from the roof of a building and the water allowed to drip through them for cooling by evaporation; (6) the roofs of buildings, which present large surfaces to the air, are sometimes used, the water being distributed from a long pipe with numerous perforations and is afterward collected by means of the ordinary rain water conductors and rain or snow which may fall upon the roof is merely added to the supply of condensing water; and the last system to be mentioned is (7) the evaporative condenser. This device is merely a pipe condenser with large radiating surface, over which water may be allowed to drip and sometimes fans are used to increase the circulation of air.

Before comparing the advantages of the different systems of cooling, attention will be given to the condensers, which may be of either the surface or jet types. The surface condenser, now used so extensively in marine practice, offers the advantage of keeping the condensing water and the steam which is condensed entirely separate. This type is used in cases where it is necessary to return the condensation to the boiler, but it has a serious disadvantage from the fact that the oil carried by the steam from the cylinders of the engine is very difficult to remove. A more or less perfect process of filtration is possible, and while most of the oil may be removed, a little is sure to remain, and frequent and continual additions of even a small amount of oil will cause an accumulation upon the heating surfaces of the boiler that is difficult to remove and is likely at any time to cause a dangerous condition. On the other hand, with the exception of the oil the condensed steam is the best kind of feed water, because it is distilled and will not cause incrustation. The surface condenser requires two pumps, the air pump which is common to all condensers, and is necessary on account of the air entrained in the steam as well as to provide means for removing the condensation and a circulating pump for the purpose of forcing the condensation water through the condenser. In connection with a cooling tower that is elevated upon the roof of a building the surface condenser has the advantage of permitting the circulating water to be moved in what may be termed a closed circuit, in which the injection water from the cooling tower balances the column of water which has passed through the condenser, and the only pumping required is that needed to overcome the friction in the pipes and the head due to the height of the tower itself. Those who advocate the use of surface condensers urge the claim that it is free from the danger of accumulating water from the condensed steam to the point of flooding the engine cylinder in case of a failure of the air pump.

The jet condenser is a very simple pear-shaped casting, very easy to manufacture and maintain, and free from the troubles incident to the large number of tubes in the surface condenser, which must be kept tight. The jet condenser requires but one pump and the injection water is drawn into it automatically by the vacuum. It is a much cheaper device to construct and we think for ordinary use has advantages over the other form. What may be considered a disadvantage of the jet condenser is that the condensed steam and the injection water are mixed, which in the case of bad waters prevents the use of this water in the boiler. The surface condenser may be a little more economical in the saving of heat units on account of the ability to pass the condensed steam into the feed heater

at a higher temperature than is possible with the jet type, but where the feed water is good it will probably pay to allow the condensed steam to make up for the loss in the cooling devices, and as the additions are always more than the evaporation losses the overflow in the jet system may be depended upon to carry away the oil. If the jet condenser is placed 34 feet above the hot well no air pump is required, and it is understood that none is used in connection with the plant of the Hyde Park Electric Company, near Chicago. The jet condenser advocates do not consider the danger of flooding the cylinder as worthy of attention, as the construction is generally made to insure the destruction of the vacuum in case the air pump fails to take away the injection water fast enough.

In considering the arrangements for cooling it may be said that the temperature of the water should not be above about 100 degrees F. in order to get a good vacuum, and the cooling water may easily be brought down to that temperature by a good arrangement of any of the plans mentioned.

The pool system has been used to a considerable extent in electric plants. A modification of it as applied on the Chicago, Milwaukee & St. Paul Railway was illustrated in the "American Engineer" of March, 1898, page 87. From successful practice it seems to be advisable to allow about 45 square feet of radiating surface per indicated horse power of the engine if the engine uses about 20 pounds of steam per indicated horse power per hour, and it is necessary to provide a circulation of the water in the pool so that the maximum radiating effect may be obtained. The pool system has been used at Hollister and Oakland, Cal.

The spray system is a convenient one and is one of the cheapest to construct. At a planing mill at West Berkeley, in California, the water for an 80 horse-power engine is raised by the air pump and passed through a spraying pipe falling 12 feet to a trough below, where it is collected and runs into the condenser at the end by gravity.

Towers are made in various forms, and they may be had ready made from the builders of condensers and steam pumps, an excellent one being described in a paper by Mr. Louis R. Alberger, read before the American Society of Mechanical Engineers in 1896. Towers with wooden spreading surfaces, occupying a space of 14 by 21 feet, have been found capable of cooling about 4,500 gallons of water per hour, which may be considered sufficient for an ordinary engine of 200 horse-power (there seems to be no definite rule as to the amount of cooling water required). In another case the water for a 250-horse-power engine has been cooled in a tower 15 by 22 feet in size and about 25 feet high, which will handle approximately 6,000 gallons per hour. The large tower for the "Alley L" Railway, in Chicago, with a sufficient capacity for 7,200 indicated horse-power, occupies a space 16½ by 64 feet and 34 feet high. These towers require fans for air circulation, and they consume about 1½ or 2 per cent. of the power of the main engine. In another case a tower 6 by 7 by 20 feet and a 50-inch ventilating fan was found capable of cooling 10,500 gallons of water per hour from 104 to 66 degrees, and it will be seen from these figures that a great deal depends upon the efficiency of the cooling surfaces in the tower; also climatic and other conditions are important.

The roofs of buildings seem to offer a favorable cooling surface and are used in England. It is clear that when a large cooling surface is necessary the water may be distributed near or at the top of the roof, and other pipes nearer the bottom may be used to distribute it in cold weather when less surface is needed. There need be no danger of freezing in these pipes, because while in use the water is warm, and the piping system may be drained when not in use.

The pan system has been successful when from 15 to 23 square feet of surface per indicated horse-power is provided. Reservoirs may be considered as out of the question for most cases, but when used it may be considered sufficient to provide about 25 square feet of surface area of the water per indicated horse-power per hour when the engine is using 13 pounds of steam. This figure is given by Mr. H. W. Barker, in a paper before the Institution of Civil Engineers. He also states that a compound engine using 16 pounds of steam requires 31 square feet, and a single cylinder engine, using 20 pounds, requires 39 square feet per indicated horse-power.

The evaporative condenser at first sight seems to have much to recommend it, but it has not made very much progress in this country. By its use the cooling water may be reduced to an amount below that of the boiler feed, and yet a good vacuum may be had; in this way it is possible to actually reduce the total amount of water used and yet secure the advantage of condensation. We think that the difficulty of keeping the condenser tight will prove a serious obstacle. The space required for one of large capacity and the great weight of the apparatus are other serious objections.

PROPOSED RAILWAY CONSTRUCTION IN FORMOSA.

Consul James W. Davidson writes from Tamsui, June 6, as follows:

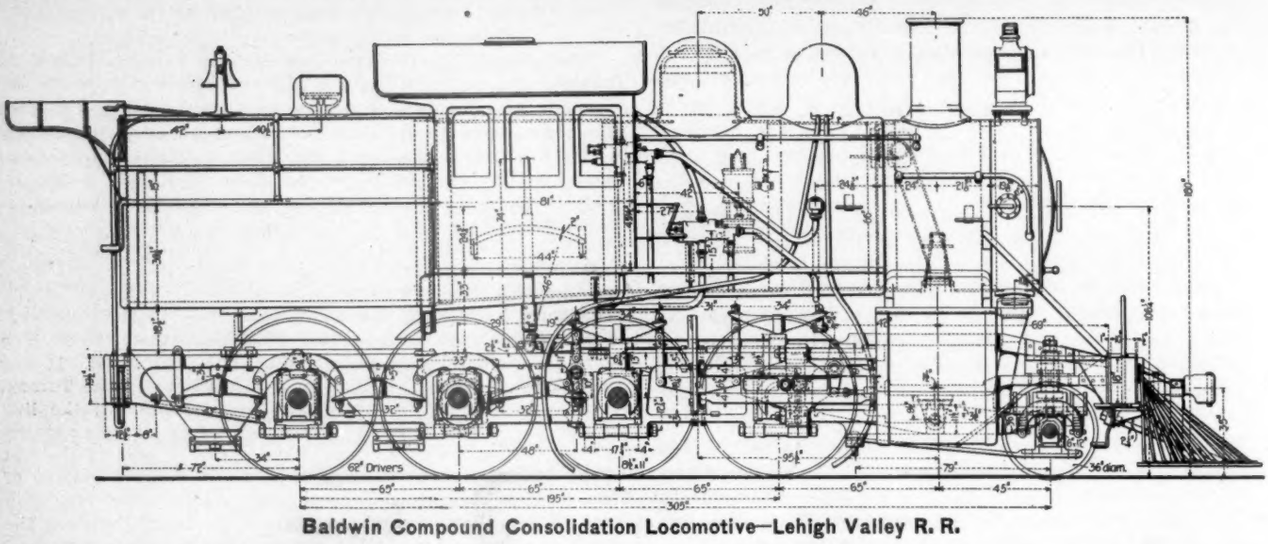
I have been unable as yet to obtain any detailed information regarding the new railway line to be constructed in the island, as Chief Engineer Hasegawa, the officer in charge, is at present in the south. Only $1,000,000 has been appropriated for the year's work, and I am informed by the chief of the communication department, it will be expended as follows: Work will be at once commenced at Takow on the Takow-Tainan branch, a line 28 miles in length. The land is quite level, and the work presents no difficulties save the bridging of two small rivers. Trains will be running over the Takow branch in two years.

The present northern line runs from the Tamsui River in a southerly direction 40 miles to Hsinchiku (Teckcham). It was built by the Chinese and completed in 1893. From the Tamsui River opposite to Twatutia, the foreign settlement, the line runs over nearly level ground for some 7 miles. It then ascends a table-land, on a maximum gradient of 1 in 30, and for the rest of the distance, with the exception of a few miles outside of Hsinchiku, it zigzags through the hills on the right side of a picturesque valley, up and down grade as though built on the model of a corkscrew. It has always been unsatisfactory, and portions of the line have been frequently destroyed by storms and freshets. Formerly, a bridge across the Tamsui River permitted the trains to run into Twaitutia; but this, as well as several bridges a few miles from Hsinchiku, were destroyed during last year's great typhoon, one large iron bridge being carried 87 yards by the force of the wind and current. At present, therefore, the line does not touch either of the original terminals.

The Japanese find that this line must be almost entirely rebuilt. A new bridge nearly 2,000 feet in length and costing some 800,000 yen ($400,000) will be constructed across the Tamsui River at Twatutia, and the route will follow in a general way the original road, though while passing through the hills it will be on the left side of the valley and by the aid of two tunnels and many cuttings will be much straighter than the old line. The bridge will be commenced this year, and the line probobly finished in two years. From Hsinchiku (Teckcham) to Tainan is 145 miles, and it is the intention to build the railway between these two points as soon as the work mentioned above is completed. This line will require numerous and expensive bridges and some thirteen tunnels. When completed it will give a railway service from Kelung to Takow, a distance of 205 miles.

I am pleased to be able to state that the chief of the communication department informs me that in all probability the locomotives, rails and bridge material will be obtained from the United States, and that the order will, he believes, go to the Carnegie Company, of Pittsburg. I am unable at present writing to give information as to the extent of this order, but will write on the subject later. The gauge of the present line is 3 feet 6 inches, the rails 36 pounds, and the ten locomotives used are of English and German manufacture. The new locomotives will be heavier than the ones at present employed, and the rails 60 pounds.

Baldwin Compound Consolidation Locomotive—Lehigh Valley R. R.



Baldwin Compound Consolidation Locomotive—Lehigh Valley R. R.

VAUCLAIN COMPOUND VS. SIMPLE LOCOMOTIVE WITH PISTON VALVES.

Lehigh Valley.

Many comparative tests have been made between compound and single expansion locomotives, and usually efforts are made to render the comparisons fair to both types, especially in regard to boiler power and steam pressure; but Mr. Higgins, Superintendent of Motive Power of the Lehigh Valley, has gone further than anyone else in this direction by giving both types exactly the same boilers and boiler pressure and piston valves. It is well known that an experiment on the Norfolk & Western Railway proved that an engine, originally a compound, when given single expansion cylinders and piston valves, beat its own previous record as a compound. Mr. Higgins' experiment is noteworthy because every possible advantage was given to the single expansion engine, and thoroughly well balanced valves exert an important influence on power and the economy.

Four tests were run with engines Nos. 801 and 802 between Buffalo and Sayre. The engines are alike in every respect except the cylinders and weights. The cylinders of the simple engine are 21 by 30 inches. No. 802, the compound, weighs 171,000 lbs. on driving wheels and 24,000 lbs. on the truck wheels, while No. 801 weighs 167,000 lbs. on the drivers and 20,000 lbs. on the truck. The tenders weighed 100,000 lbs. in working order. We described and illustrated the compound in our issue of April of the current volume, but for convenience and because of the interest in the test, the diagram of the design is reproduced.

During the tests stops were made at points on the division where it was known to be most difficult to start trains, and it was found that the compound always started without taking up the slack between the cars. Engine No. 801 started the trains from these points, but it was necessary to take up the slack several times, which showed the advantage possessed by the compound in starting. There was a decided difference in the steaming qualities of the engines in favor of the compound. The boiler pressure was 200 pounds in each case. In computing the results the net tonnage does not include the weight of the engines and tenders. Both engines were designed by the railroad company, under the direction of Mr. Higgins, and they were built by the Baldwin Locomotive Works.

This design was prepared specially for the Buffalo division, where there are long grades, one of which is 21 feet per mile and 37 miles long; and another 18 feet per mile and 30 miles long. The engines were built to pull 2,000 tons, not including the engine and tender, and each was to do the work which formerly required two of the locomotives previously used on that district.

The tests were carried out with exceptional care and the results leave no doubt as to the advantage of the compound both in fuel economy and in convenience in operating. The fuel used was a mixture of 80 per cent. buckwheat and 20 per cent. bituminous. The speeds when the pairs of runs are compared are very nearly the same and there were no differences in the rail or weather conditions. The cars were all loaded and when the runs are paired the trains are seen to be very nearly alike in weight. It would be difficult to secure more comparable conditions in road tests. Taking the average results the compound showed an advantage of 13.4 per cent. in fuel per ton

mile and as a result of the tests the Lehigh Valley Railroad has ordered 23 Vauclain compound locomotives like No. 802.

A summary of the results and a brief table of dimensions of the locomotives are given below:

VAUCLAIN COMPOUND LOCOMOTIVE COMPARED WITH SINGLE EXPANSION LOCOMOTIVE HAVING PISTON VALVES.

LEHIGH VALLEY R. R.

Test number	1	2	3	4
Engine number	802	801	802	801
Date	May 23	May 24	May 25	May 26
Distance in miles	172	172	172	172
Controlling grade	21.62 ft.	21.62 ft.	21.62 ft.	21.62 ft.
Atmospheric pressure	65 deg.	70 deg.	70 deg.	67 deg.
Tonnage, net	2,193	2,196	2,002	1,990
Number of cars	61	57	47	49
Loaded cars	61	57	47	49
Cars less than 60,000 lbs. capacity	20	8	0	0
Cars of 60,000 lbs. capacity	40	48	46	48
Average load per car, tons	35.95	38.53	42.59	40.60
Departure from E. Buffalo	7:04 A. M.	7:04 A. M.	9:35 A. M.	9:09 A. M.
Arrival at Sayre	9:03 P. M.	9:08 P. M.	9:15 P. M.	9:20 P. M.
Running time	10 h., 23 m.	10 h. 0 m.	8 h., 51 m.	9 h., 12 m.
Average speed, miles per hr.	16.56	17.20	19.43	18.70
Fuel used, in tons	16.29	17 66	11.85	14 7
Fuel used per ton mile, lbs.	0.0864	0.0935	0 0688	0 0858
Water used, gals.	24,783	25,558	21,139	22,935
Water evaporated per lb. fuel, lbs	6.33	6.03	7.43	6.50

Cylinders, compound	17 and 28 by 30 in.
Cylinders, simple	21 by 30 in
Driving wheels, over tires	62 in.
Rigid wheel base	16 ft. 3 in.
Total wheel base	25 ft. 5 in.
Height from rail to top of stack	15 ft.
Boiler pressure	200 lbs.
Boiler diameter	66 in.
Heating surface, firebox	177.7 sq. ft.
Heating surface, tubes	2,809.6 sq. ft.
Heating surface, total	2,987.3 sq. ft.
Firebox, length	113 in.
Firebox, width	96 in.
Tubes, 358, two inch, length	15 ft. 1 in.
Piston rods hollow, diameter	4½ in.
Driving journals	8½ by 11 in.
All drivers flanged	
Engine truck wheels	36 in.
Water capacity of tender	4.500 gals.

MR. QUAYLE'S PRESIDENTIAL ADDRESS.

Master Mechanics' Association.

The following suggestive review of the motive power situation is abridged from the address of President Quayle before the Master Mechanics' Association, at Old Point Comfort:

"Since our last convention we have seen a very marked advance in the weight and power of locomotives, both passenger and freight. More powerful locomotives are necessary, and yet the track must not be made to suffer; and this, I believe, may be accomplished. We may need to increase wheel loads somewhat, but by using larger driving wheels the counterbalance weights may be made even less destructive than small wheels with lighter loads. We ought to build engines that will haul at least 2,000 tons on grades of from 0.6 to 0.7 of 1 per cent., and instead of driving whels of 55 inches for road engines, on lines with ruling grades less than 1 per cent. we ought to use 60 inches. On such roads, by increasing train loads from 1,500 to 2,100 tons, we ought to save not less than half the cost of the heavier engine per year.

"The greatest possibilities in saving, by the use of more powerful locomotives, are in the wages of engine and train crews. The expense of running a freight train for trips of about 100 miles at ten miles per hour, which is uniform regardless of weight of train and the grades, is about $22. The cost of coal will be less per ton mile for heavier trains, but it is this constant charge for crews which affects the saving when their number is reduced. The labor cost at the round house will be somewhat greater per engine mile, but when compared, on the basis of ton miles it must be less, even when the labor of wiping is included. The wages of engine dispatchers are the same for heavy as for light engines, but since a smaller number are required for a given amount of work, this expense should be less with those that are more powerful.

"The saving in coal is next to that of labor, and within the proper limits of the capacity of the engine and of speed, the heavier the train the less coal is required per ton mile. This argument applies to the loading of engines, whether heavy or light, but its force is greatest in connection with very powerful locomotives. This may be demonstrated by coal reports kept for relatively long periods. It takes more oil to lubricate a heavy engine than a light one, but this, too, should be referred to the ton mile, when it appears as a saving in spite of the great increase in steam pressure and the dimensions of journals. The same holds true in regard to the cost of repairs. They also will increase, but not in proportion to the additional work done. With two engines operating on the same grades, one built to haul 600 tons and the other 900 tons, the relative total cost of operation per 1,000 ton miles may be taken as the ratio of about 47 to 36, or a difference of about 25 per cent., or more than is usually expected from compounding.

"The tendency toward heavier loading has been favorable to compounds, because of the possibilities of greatly increasing their pulling power at critical points on summits by the use of live steam in the low-pressure cylinder.

"The possibilities of lightening parts by the use of improved material, whereby capacity may be increased without increasing weight, should be utilized to the utmost. Larger boilers may be built without increase of total weight, and we may be encouraged in this by the great improvement of recent years in marine work.

"It would take too long to do more than partially enumerate the directions in which we may improve locomotives. The following need our attention: The reduction of waste power of the cylinder by reducing back pressure and condensation; piston valves; feed water purification; the forms of fireboxes and other factors tending to reduce staybolt strains and failures; more thorough lagging of the boilers at the sides and front of the firebox; the further use of cheap fuels and care in the matter of details which will prevent engine failures on the road. All of these subjects are before us and all of them give promise of good returns for the time and money spent upon them.

"The distribution of power in shops needs thought. We have electricity, compressed air and also the gas engine to aid us, and I predict that after ten years we shall look back with surprise at the prevailing shop power methods of the present. We need more power cranes and more modern and powerful tools. We must give more attention to the cost of work and to those commercial methods that make success or failure in manufacturing establishments. The welfare and comfort and the surroundings of our men, both on and off duty, interest us now, but much more ought to be done in these matters in the lines of reading rooms, places of recreation, and in providing lectures, instruction and entertainment. We should use the technical papers intelligently. It is a good plan for the head of the motive power department to mark articles and send them to the master mechanics and such other employees, as they may deem wise, asking for comments and suggestions."

NEW CARS FOR THE EMPIRE STATE.

Some of the new coaches for the Empire State Express of the New York Central have been placed in service and are very handsome. They have a capacity for 85 passengers, while those heretofore in use accommodated only 65. This will make it possible to carry a greater number of passengers on this train, and take care of all who seek its advantages. The new cars have six-wheel trucks and full width vestibules, with anti-telescope steel platforms. The interior finish is inlaid mahogany, the carvings and decorations being in entire harmony. The seats are highbacked, and the car roof is dome shaped, its decoration being in green and gold.

TITLE INSCRIPTIONS ON DRAWINGS.

In the routine of the drawing office the work of placing titles on tracings is a matter of considerable importance and causes a great sacrifice of time when done by hand, no matter how expert the artist may be at either freehand or instrument work. This fact, taken in connection with the lack of uniformity in hand work, has led to devising schemes by which a title may be quickly printed on a drawing, and at the same time give a creditable appearance and also preserve a distinctly uniform style. All this is accomplished by means of moveable type easily set in a frame, and while the results are not of the ornate order so dear to some draughtsmen, they are less costly and serve the purpose perfectly. In reply to our inquiry of Mr. F. M. Whyte, Mechanical Engineer of the Chicago & Northwestern Railway, for his practice in this line, Mr. Whyte writes as follows:

"In regard to the use of a printing press for printing titles on tracings, we are using a small handpress for this purpose, the frame of which measures 4 by 6 inches. When it was first proposed to purchase a printing press the one we have was considered sufficiently large; but it has been remarked several times since that it would have been better had we purchased a larger one. The length of the frame given above limits the length of the title, but we find it large enough for the purpose, as we try to make the title as short and expressive as possible. We have three fonts of type, and you can judge of their size by the attached print. We find these sizes of type convenient and quite satisfactory. I might tell you our experience which practically drove us to the adoption of a hand press. First, of course, it costs considerable to put titles on drawings whether the work is done with the usual drawing instruments or by freehand. To reduce this cost, we tried first to use a rubber stamp, but the ink which we found would work satisfactorily with the rubber stamp would not give a print, so that, after putting the title on with the stamp, we would have to turn the tracing over and ink it on the back with black drawing ink. This, of course, was no great improvement on putting the titles on by hand. We found we could not use black ink on the rubber stamp, because the gasoline used for removal of the ink from the stamp after using it would destroy the rubber type. It was also difficult to get a perfect impression with the rubber stamp. The first difficulty experienced with the hand press was that the ink would not dry fast enough after the title had been put on the tracing, but this trouble was overcome by using a light, fine powder to absorb the ink, so that we now take a print from the tracing immeditely after titling it. Fine powder should be used, because, otherwise, the large flakes of coarse powder will overhang the edge of the letter and produce ragged edges. We use the ordinary quick-drying printers' ink for our press. The first cost for us was $22.50 for the complete outfit, and it is believed that the first month or two's saving would cover

Y. X. & Z. RY.

CYLINDER, 18"X24"

PATTERN DRAWING

CHICAGO, ILL. JAN. 5, 1899.

APPROVED CORRECT

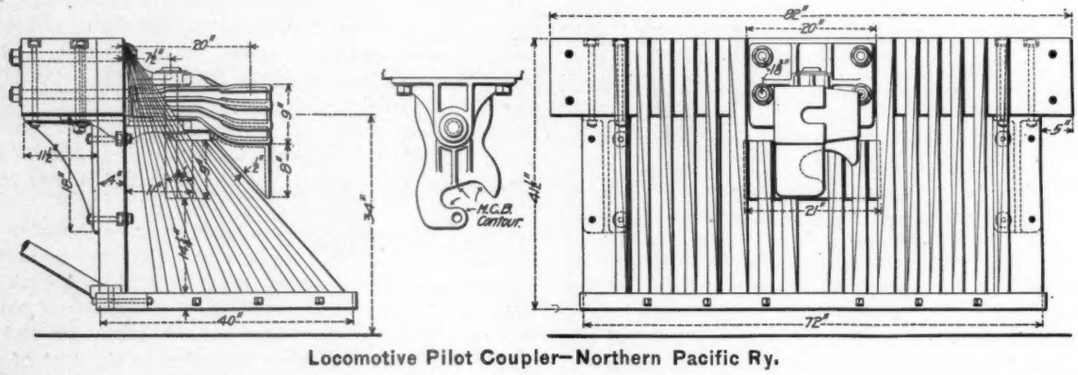
SUPT. M P. MECH. ENGR. 4567

The style of letter and general appearance of this method of lettering may be noted from the example furnished in our illustration, which is reproduced from the sample sent us. It is not a work of art, but it is fitting for the purpose, and the practice indicates an intention to get the greatest possible value out of he drawing office force.

LOCOMOTIVE PILOT COUPLER.

Northern Pacific Railway.

The standard pilot of the Northern Pacific Railway is shown herewith, together with the steel coupler as now used, which has replaced the cast iron drawhead, for a long time a standard of that road. The casting seen under the coupler is a guard to prevent stock from being wedged between the pilot and coupler. This guard or shield was cast solid with the pattern of drawhead, but is bolted under the new coupler and swings laterally with it, just clearing the pilot slats. The coupler does not uncouple, having simply the M. C. B. contour lines, but no knuckle. It has a limited lateral movement and is held in the central position by springs.



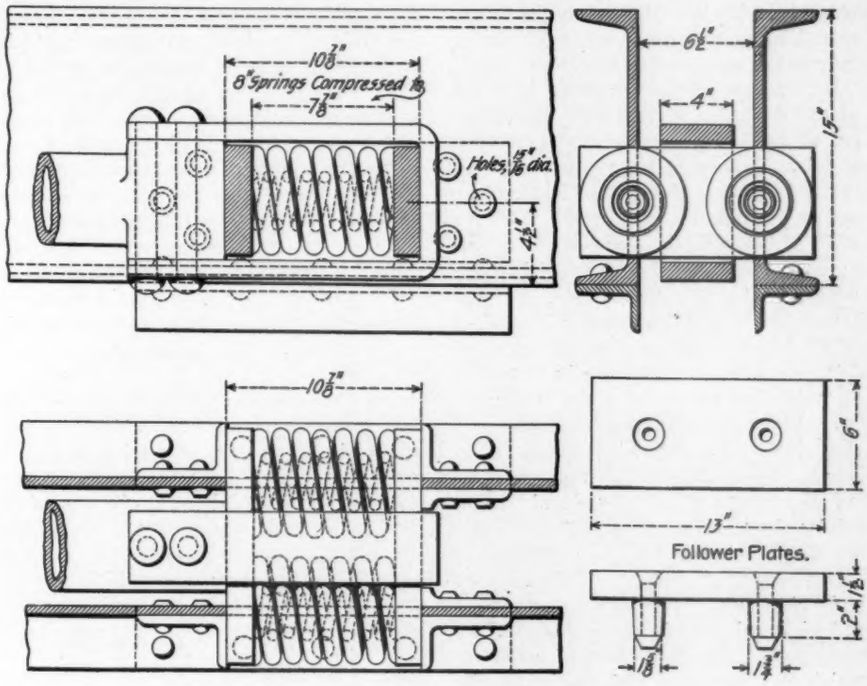
Locomotive Pilot Coupler—Northern Pacific Ry.

The steamship "Deutschland," now building for the Hamburg-American Line at the Vulcan yards near Stettin, Germany, will be faster and larger than the North German Lloyd liner "Kaiser Wilhelm der Grosse." The new vessel will have an average speed of 23 knots, her length over all will be 686½ feet, length on water line 662 feet, beam 67 feet 4 inches, draft 29 feet, and displacement 22,000 tons. Her engines are to maintain 35,000 horse-power. The boiler pressure will be 225 pounds per square inch and the twelve double and four single boilers will have a total of 112 furnaces. The specifications call for 23.12 knots on the trial and 23 knots sustained speed. The ship is expected to be ready for service early next summer. While not as large as the new White Star liner "Oceanic," the speed will be much greater. The German ship will accommodate 736 first class, 300 second class and 282 steerage passengers, a total of 1,320.

SIMONS DRAFT RIGGING FOR STEEL CARS.

Mr. J. E. Simons, Assistant Master Car Builder of the Pittsburgh & Lake Erie, has given a great deal of attention to the improvement of draft attachments in order to keep these parts up to the requirements imposed by the increasing severity of the demands upon them. Draft gear for large cars needs attention in three directions: 1. Increased spring resistance to receive and cushion all the draft stresses without closing up. 2. Stronger attachments to receive the thrusts of the followers, and 3, more direct transmission of the stresses from the coupler to the underframe of the car.

In the draft gear, designed and patented by Mr. Simons, which is illustrated here, these features have all received attention, but particularly the last two. The center sills are I beams, through the webs of which slots are cut to receive the follower plates and the draft springs, the springs being centered to bring the stresses directly upon the webs of the sills, indicated in the drawing. The webs are too narrow to give sufficient bearing area for the followers, and angles are riveted to them to increase the bearings, and short angles are riveted to the bottom flanges of the center sills in order to compensate for the amount of material cut away from the webs.



Simons' Draft Gear for Steel Cars.

Mr. Simons uses double draft springs and from his remarks before the M. C. B. Association at Saratoga in 1898 it is evident that he appreciates the necessity for increasing the spring resistance of draft gear. He directed attention at that time to the fact that the draft of long trains of heavily loaded cars of large capacity caused the draft gear to close up solid instead of carrying the stress with the elasticity of the springs. He has succeeded in getting the stresses into direct line with the resistance of the sills. He avoids the use of eccentrically loaded draft lugs altogether, and the few rivets used are well disposed and are not in tension.

"When taking his first step from college it is most important to shun influential friends who have it in their power to place you in positions beyond your experience; remember it is just as important to progress step by step in the practical work in your profession as it is to follow your regular course in the university."—[Mr. John Stirling Deans' address before the students of Lehigh University.]

LOCOMOTIVES IN GERMANY.

Germany has eighteen shops turning out locomotives both for home and foreign use, according to a recent letter from Consul J. C. Monaghan, from Chemnitz, fifteen of these build both large and small engines, and three build nothing but small ones for light work. These can furnish annually, under normal conditions, 1,400 engines. They employ from 15,000 to 20,000 workmen—the number depending upon the orders. Germany exports locomotives to Russia, Sweden, Norway, Denmark, Turkey, South America, South Africa and Asia. A house here sent nineteen a year or two ago to the Dutch East Indies.

Up to date, as far as can be found out, no United States engine, says Mr. Monaghan, has entered this Empire, although England has ordered a number. A writer, whom I quote freely, says that work can be more effectively done in the United States, because only a few well tried forms of engines are made. "In consequence of this," he continues, "the parts are put up and kept in supplies by all parties acting as agents of such engine builders. This enables those buying American engines to replace broken or injured parts almost instantly." German writers say the firms in Europe could do the same in the time put down for delivery, etc., were it not for the fact that every railroad company, every engineer, wants a particular type. They go so far as to express preferences for different kinds of different parts, and every change of officials or engineers having charge of the purchase of locomotives or their parts brings change in the articles used. Consequently, Germany has found it impossible to keep a supply of parts. 'This,' says the writer referred to, 'may keep Germans from overproduction, etc., but it has the disadvantage of delaying deliveries. An understanding among the builders of locomotives might lead to a system not only advantageous to the Empire, but useful to the exporters of locomotives. It would help to keep territory already captured in far-off lands and fit Germany to meet America's rapidly rising influence.'

"It is hardly necessary to say that American locomotive builders will do well to look these lines over. They have never had such a chance as now. All Asia, Africa, Australia, North and South America, many states of Europe, particularly Russia, offer markets which we are the only people fully equipped to supply."

AIR BRAKE DECISION.

Westinghouse vs. New York.

The United States Court of Appeals for the Second Circuit handed down a decision July 18 in the suit of the Westinghouse Air Brake Company against the New York Air Brake Company for the infringement of certain claims of patents No. 538,001, granted to George Westinghouse, and 382,032, granted to Theron S. E. Dixon. The suit was first tried before the circuit court and won by the defendants. The appeal resulted in sustaining the decision of the lower court. The opinion was written by Judge Shipman and concurred in by Judge Thomas, while Judge Lacomb dissented as to the infringement of patent No. 538,001 and agreed with the others as to the Dixon patent. The opinion is too long to be reproduced in full, but a brief abstract will be interesting as a matter of record.

It is recognized that the success of the air brake is based upon the promptness of the reduction of the train pipe pressure and the equalization of the pressure in the brake cylinder and the auxiliary reservoir. Formerly the venting was all done at the engineer's valve, and the quick action feature was added by Westinghouse by venting at each triple valve in emergency applications, in addition to the venting at the engine, which resulted in greatly hastening the action. Westinghouse also saved air and augmented the brake power by venting the train pipe into the brake cylinder at each triple valve, thus utilizing the vented air for obtaining the initial charge of the brake cylinder. This emergency action was inaugurated by a large reduction of train pipe pressure at the engineer's valve, which effected the venting at the triples by means of a "further traverse" of the triple valve piston beyond the traverse employed in ordinary service applications in the first form devised. On account of the comparatively small air ports which were thus opened by the "further traverse" the brake was improved by the use of a supplementary piston to operate the valve controlling the emergency passage, and in both cases the venting from the train pipe to the cylinder was controlled by the "further traverse" of the piston of the triple valve.

In 1892 a further improvement was made and a compound piston was employed, which was connected with the brake cylinder piston, which took the place of the "further traverse" of the triple valve piston to uncover the emergency port. The speed of the operative piston rather than its length of movement being the means by which the vent valve was opened. This patent was applied for in 1892 and it remained in the patent office for three years on account of changes in claims. The court says that no claim was made for a broader scope of this patent than that of covering a method of venting air to the brake cylinder until March, 1895, when the defendants called the complainants' attention to a method proposed by them for venting the train pipe to the atmosphere. This led to the addition of six new claims to the patent application of 1892, which were allowed, and by which the scope was enlarged to make them apply to venting to the atmosphere.

The complainants contended that the invention was of a broad and primary character, covering the arrangement for operating a vent valve whereby the opening depended on the rate or manner of movement of the primary part of a compound piston. The defendants held that the mode by which the train pipe is vented to the brake cylinder constituted the scope of the invention, while the complainants claimed that the operation to locally exhaust the air independent of the subsequent disposition was covered by their patent.

The court said that Westinghouse did not contemplate venting to the atmosphere or to a separate chamber and did not show how this could be accomplished; furthermore, the progressive history of the invention had shown that such delivery was not considered as the most beneficial for quick action brakes while the desired object was to obtain increased brake cylinder pressure because of the venting of the train pipe into it and giving greater speed and force to the application of the brakes.

The opinion of the court was that while venting to the atmosphere was suggested in the complainants' patent, yet the means where atmospheric venting could be accomplished in the quick acting air brake would require invention and was not covered by the claims. Furthermore, Westinghouse confined himself to the use of the vented air in the cylinder. If the question depended on the restriction of the Westinghouse claims to the mechanism shown there was no infringement. On this point the opinion says: "We are therefore of opinion that the claims inserted by amendment of 1895 must be limited to a piston attached to or moved by the brake cylinder piston for venting the train pipe into the brake cylinder."

The defendants' valve designated as "Valve C" vents into the atmosphere, using a compound piston, which is a part of the triple valve piston, the action of which is not a part of that of the brake cylinder piston, the service and emergency operations being obtained by varying speed, using methods similar to those of the Westinghouse patent of 1895.

This patent was judged not to have been infringed.

The Dixon patent employed a single piston, which in its preliminary traverse moved only far enough to open a valve to admit air from the auxiliary reservoir to the brake cylinder, while its further traverse, caused by an emergency application, opened a vent valve from the train pipe to the atmosphere. A valve was added to close that vent opening by means of another piston, which was actuated by air pressure from the brake cylinder when the cylinder pressure became sufficiently great for the purpose. The Dixon patent was, in general, similar to the first Westinghouse quick acting patent, No. 360,070, except that Dixon vented into the atmosphere. The New York triple has a compound instead of a simple piston and does not use the preliminary traverse.

In the opinion of the court it was held that the invention of the Dixon patent is a subordinate one, which consists in using the venting mechanism similar to the Westinghouse quick action patent, No. 360,070, but which provides that the air vented from the train pipe shall pass direct to the atmosphere instead of to the brake cylinder and necessarily includes additional mechanism for closing the train pipe vent valve at the proper time. The court holds that the mechanism by which the train pipe vent valve of the defendant's triple valve is opened is of a different character from that employed in the Dixon patent in that a compound piston of a single range of movement is used where Dixon employed a simple piston of two ranges of movement. In a subordinate patent no such broad range of equivalents could be granted as would include the defendant's compound piston within the scope of Dixon's piston arrangement.

Westinghouse contended that the character of the Dixon patent was sufficiently broad to include the use of the defendant's compound piston as an equivalent of Dixon's. The court seemed to regard this as the turning point of the case as far as the Dixon patent was concerned and decided that the invention was not one of sufficiently primary importance to warrant such a construction. The court held that the Dixon patent had not been infringed.

Thus in both cases the decision of the lower court was sustained.

If you were told of a steam plant with a boiler capacity of 4,000 horse-power, with electric generators capable of developing 1,500 kilowatts, with 25,000 electric lights, with a refrigerating plant having a cooling capacity equal to the melting of 150 tons of ice per day, with pumps sufficient to handle the water supply for a city of 400,000 inhabitants, a plant which has 152 steam and 102 water cylinders and 56 electric motors, and a force of 116 men in the engineers' department, would it occur to you that it was simply the mechanical plant of a hotel? All this and more is true of the Hotel Waldorf-Astoria in New York City.—"Power."

HEAVY TEN-WHEEL PASSENGER LOCOMOTIVES.

New York Central.

The New York Central has received several locomotives of the ten-wheel type of a lot of ten from the Schenectady Locomotive Works, which, with the exception of the Brooks simple 10-wheel engines built in 1898 for the Great Northern, and the Schenectady compounds of the same type for the Northern Pacific, are the heaviest passenger locomotives of which we have record. The comparison of weights is as follows:

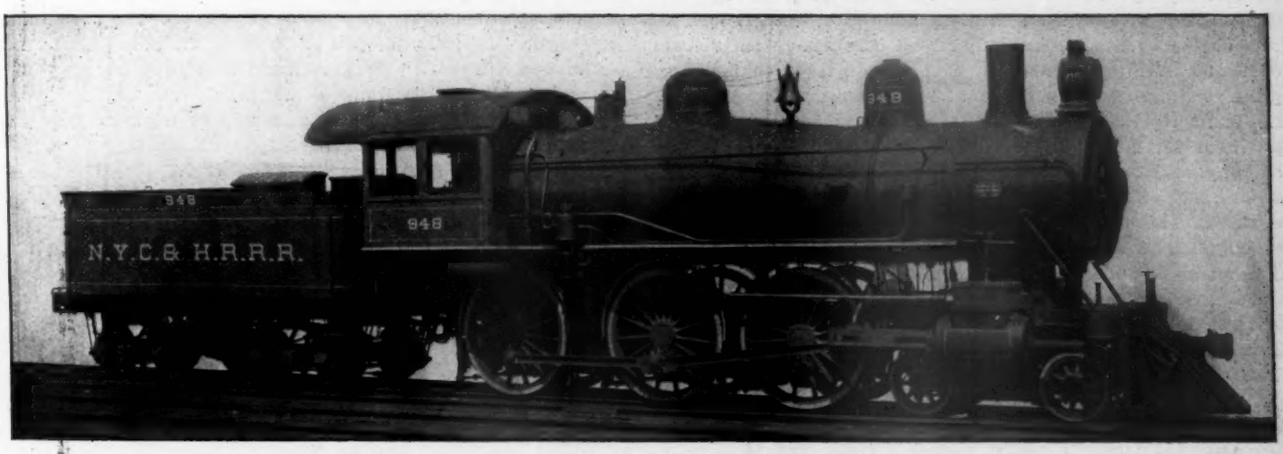
	N. Y. C.	Gt. N.	N. P.
Weight total	164,000	166,000	172,500
Weight on drivers	126,000	129,000	126,000

The New York Central engines have cylinders 20 by 28 inches, driving wheels 70 inches, and the driving journals are 9 by 12 inches. The heating surface is 2,886 square feet, which is within 9 square feet of that of the Northern Pacific compound already referred to. These compounds have 2,895 square feet of heating surface, which is the largest in passenger service. Other dimensions are included in the table given below. These engines will be used on the fast trains between New York and Buffalo, and it is understood that they were ordered before the recent changes in the heads of departments on the road.

Thickness of plates in barrel and outside of firebox,	21/32 in., ¾ in., ½ in. and 11/16 in.
Firebox, length	108⅛ in.
Firebox, width	40⅜ in.
Firebox, depth	F. 83⅛ B. 71⅛ in.
Firebox, material	Carbon steel
Firebox plates, thickness	sides, 5/16 in., back, ⅝ in., crown, ⅜ in., tube sheet, ½ in.
Firebox, water space	4½ in. front, 3½ in. sides, 3½ to 4½ in. back.
Firebox, crown staying	Radial stays 1⅛ in. diam.
Firebox, stay bolts	1 in. in diam.
Tubes, material	Charcoal iron No. 11
Tubes, number of	360
Tubes, diameter	2 in.
Tubes, length over tube sheets	14 ft. 4 in.
Heating surface, tubes	2,685.99 sq. ft.
Heating surface, water tubes	12.64 sq. ft.
Heating surface, firebox	187.53 sq. ft.
Heating surface, total	2,886.16 sq. ft.
Grate surface	30.32 sq. ft.
Exhaust pipes	Double high
Exhaust nozzles	3¼ in., 3⅜ in., 3½ in. dia.
Smoke stack, inside diameter	16½ in.
Smoke stack, top above rail	14 ft. 9¼ in.
Boiler supplied by	2 Monitor injectors

Tender.

Weight, empty	45,500 lbs.
Wheels, number of	8
Wheels, diameter	33 in.
Journals, diam. and length	4½ in. dia. x 8 in
Wheel base	15 ft. 10 in.
Tender frame	10 in. channel iron
Water capacity	4,500 U. S. gallons
Total whel base of engine and tender	52 ft. 8⅜ in.
Tender fitted with water scoop.	
Coal capacity	10 tons



10-Wheel Passenger Locomotives—New York Central & Hudson River R. R.

General Dimensions.

Gauge	4 ft. 8½ in.
Fuel	Bituminous coal
Weight in working order	164,000 lbs.
Weight on drivers	126,000 lbs.
Wheel base, driving	14 ft. 8 in.
Wheel base, rigid	14 ft. 8 in.
Wheel base, total	26 ft.

Cylinders.

Diam. of cylinders	20 in.
Stroke of piston	28 in.
Horizontal thickness of piston	4½ in. and 5 in.
Diam. of piston rod	3⅜ in.
Kind of piston packing	3 cast iron rings
Size of steam ports	18 in. x 1¼ in.
Size of exhaust ports	18 in. x 2¾ in.
Size of bridges	1⅛ in.

Valves

Greatest travel of slide valves	5½ in.
Outside lap of slide valves	1 in.
Inside lap of slide valves	0 in.
Lead of valves in full gear	0 in.

Wheels, Etc.

Diam. of driving wheels outside of tire	70 in
Material of driving wheel centers	Cast steel
Driving box material	Cast steel
Diam. and length of driving journals	9 in. dia. x 12 in.
Diam. and length of main crank pin journals	6 in. dia. x 6 in.
Diam. and length of side rod crank pin journals,	Main side 6¾ in. x 5¼ in. F. & B. 5 in. dia. x 3¾ in.
Engine truck, kind	4-wheel swing bolster
Engine truck journals	6¼ in. dia. x 10 in.
Diam. of engine truck wheels	33 in.
Kind of engine truck wheels	Krupp steel tired spoke with 2⅝ in. tire

Boiler.

Style	Extended wagon top
Outside diam. of first ring	66 5/16 in.
Working pressure	200 lbs.
Material of barrel and outside of firebox	Carbon steel

ELECTRIC VS. STEAM TRACTION.

At the recent annual meeting of the American Society of Civil Engineers, at Cape May, N. J., the following topic was presented for discussion:

"What are the economic conditions under which electricity may be profitably substituted for steam in the operation of branch railroad lines, and what are the engineering requirements to be considered in such substitution?"

Col. H. G. Prout, Editor of the Railroad Gazette, stated the case clearly and forcibly by showing that the question was purely one of traffic conditions. Except for frequent, short trains doing a suburban business or street railway business, there was no advantage in electricity so far as the cost of power was concerned. A 1,000-horse power locomotive costs $10,000, while a stationary power house plant of equal capacity costs about $80,000, and any gain in the fuel economy through the use of the electric motor would be more than offset by the greater first cost of the plant. The fuel cost was a small item in the total expense of operating, and the advantage of the electric motor over the locomotive, if any existed, must be sought in other directions than in fuel economy.

This is a clear statement of fact and it ought to cause advocates of electric traction to trunk line service to subside until such service becomes suitable for electric subdivision of power, or, in other words, until "the train service becomes so frequent and steady as to resemble the movements of buckets upon a grain elevator."

FAVORABLE ENGLISH OPINIONS OF AMERICAN LOCOMOTIVES.

The following extracts from an editorial in "The Engineer," of London, July 7, 1899, are interesting to those who have followed the recent march of events in locomotive practice, with particular reference to the use of American designs in foreign service:

If a railway was absolutely smooth, level, straight and unyielding, springs would be wholly unnecessary. The worse the road the greater is the need for flexibility and elasticity. It is an open secret now that in certain trials which took place a good many years ago in France, between French and English locomotives, the French engines always beat the English in speed; and we have no doubt that the reason given at the time was the true reason. The English engines, regarded as vehicles, were too stiff for the French roads. Now, the American engine, built for bad railway tracks, with its spring rigging, compensating beams, bar frames, and loosely-fitting axle-boxes, works like a basket on the road, and runs with a freedom of which an accurately-made and fitted machine like a first-class English locomotive is quite incapable. It is the want of perception of this truth which has caused English engineers to draw up specifications which are thoroughly mischievous, and inspectors to condemn, in their ignorance, work that is essential to success. We can only repeat here what we have said over and over again, namely, that to construct colonial engines, or engines for such countries as South America, with the same rigidity of boxes and springs, the same paucity of provision for lateral and vertical motion, as distinguish English engines running on the best track in the world, is to court failure, and to entail on the unfortunate engineer who has to work with these locomotives an immense amount of worry, resulting at last in the alteration of details, and what is almost tantamount in some cases to a rebuilding of the engine.

We have never said that English locomotive builders cannot build engines quite as easy on a road as anything that American shops can turn out. Nay, more, if the builders were left to themselves, they could turn out better engines. But it is a matter quite notorious that the builders have to work to specifications, and that there are not drawn up with an intelligent perception of what is really wanted. These are facts that ought not to be forgotten. In this country, from a very early period great attention was paid to track. Brunel proposed that a car with two huge grindstones, caused to revolve by an engine, should be run over the road to remove every asperity and reduce the rails to a dead level surface. In the United States the early railways had a track of longitudinal timbers, on which were spiked flat bars of iron 2½ in. wide and ½ in. thick—the well-known "strap rail," in fact. The locomotives which ran over this permanent way were of necessity extremely flexible; and flexibility was obtained by the use of bogies, balance beams, and enormous side-play—things wholly unknown in this country. Such an engine as Gooch's North Star could not have run ten miles on a strap rail track. But American engines managed to do their 25 miles an hour on it without difficulty. The lessons thus learned by American locomotive designers have never since been forgotten. They have modified American practice ever since; and the result is that to this day the American engineer loves to impart a flexibility to his engines, which is regarded as an absolute defect by not a few influential engineers in this country. In a few words, experience is the foundation of all knowledge; and Americans have had for more experience—half a century of it at least—of bad roads than we in this country have had. It is not surprising that they should be able to teach us something in this connection, and, however unpleasant it may be to some persons to admit it, it is none the less certain that the English-built locomotive intended for service on a bad road will or will not be successful just in so far as it does or does not embody those principles of construction which our American rivals have deduced from a very extended and varied experience.

From various parts of the world statements reach us to the effect that the comparatively roughly-made American engine is a more satisfactory machine than its beautifully finished English or Scotch made brother. We see no reason why such statements should be made if they are not true. We have read specifications for engines, and we have made ourselves acquainted with the practice of inspectors, and bringing our own knowledge of the facts to bear, we are certain that the engines which result from the specifications and inspection are not the best adapted to the intended work. We do not wish to criticise individuals, and we find it hard to state cases by way of illustration, which will not seem to press hardlly on this man or that; but we may say that we can call to mind one instance in which six-wheeled engines with rigid plate frames, and a comparatively long wheel base, were set to work against American engines of much rougher make with four wheels coupled and a bogie. The English engines burst the road, ran off it, and did such mischief that they were thrown on one side and the American engines did all the york. We can call to mind another case, in which two beautifully made engines, build to special design for the 5 ft. 3 inch gauge, played such havoc with a very bad road that they had to be practically rebuilt, the wheel base shortened, and the axle-boxes cut away to give side play, before they could be used. We have seen engines with the cylinders thrown so far forward to get a short wheel base that the engines literally jumped themselves off a bad road, and could not be used till they were fitted with pony trucks, which the designer would not have at any price. The highest excellence of material and the utmost beauty of workmanship will not compensate for such defects of design.

We need scarcely say that it affords us no particular pleasure to write thus. But, on the other hand, we have the best interest of the locomotive builders of this country at heart, and we should wholly fail in our duty if we said pleasant things, and maintained that the typical English locomotive must be best for Australia or South America, or China, or Africa, just because it is the best for the railways of the United Kingdom. We repeat that Americans more fully understand what is wanted for railway service in a new and cheap country than we do, and that we ought not to be too proud to learn from them. The locomotive-building firms in this country are by no means numerous; and we venture to say that they have nothing to learn from Americans or anyone else. But this is not true of other people in this country, and it is the other people who settle what the locomotive for distant lands shall be.

The cost of a modern office building in New York City is stated by Mr. R. P. Bolton, in a paper before the American Society of Mechanical Engineers, to be from 36 to 40 cents per cubic foot of its gross volume, outside measurement. The excessively high and very highly ornamented buildings cost more. The total cost of mechanical appliances in a 16-story building, with basement and sub-basement, having about 6,000 square feet of renting area per floor, was $82,000.

WESTINGHOUSE BRAKES IN RUSSIA.

It was announced in our columns some time ago that the Westinghouse Air Brake Company had made arrangements to manufacture brake apparatus in Russia. The works are now completed and running, and with the receipt of this news comes an announcement that the company has just closed a contract with the Russian Imperial Railway Commission to equip all of its cars during the next four years with Westinghouse brakes. The contract was awarded as a result of tests made by the commission, and it covers the equipment of both freight and passenger stock. Statistics whereby the exact mileage and amount of rolling stock to which this contract applies are not available, but it is safe to say that it includes about 24,000 miles of government roads aside from about 8,000 miles of private roads which are likely to be equipped with this apparatus.

BOILER STEEL WORKED AT TOO LOW TEMPERATURES.

The danger of working boiler steel at "blue heat," or at temperatures of from 700 down to 550 degrees F., is well known, but in spite of this the practice is often seen and it will probably continue to be common until the general introduction of flanging presses is accomplished. Prof. H. Wade Hibbard brought the subject before the New York Railroad Club in a paper recently read, and in the discussion it became clear that the use of the flanging press is one of the greatest of recent improvements in locomotive boiler making.

Blue working without annealing is forbidden on work for the United States Navy, as was stated by Mr. L. R. Pomeroy, who also presented records of the Board of Trade tests at the Steel Works of Scotland, where 48 plates were tested by coupons cut from each, half of which were bent cold to an angle of 180 degrees around a bar of a diameter of twice the thickness of the strips. Corresponding strips were heated in boiling tallow and bent at this temperature, whereupon every one cracked before reaching 180 degrees. A plate heated and cooled was stated to be no worse for the operation, but if, while cooling, the steel is worked at the blue heat, it will be found to be seriously injured in quality.

Mr. Pomeroy said that Mr. Stromeyer, in 1896, was among the first to call attention to the injurious effects of working steel at blue heat. The most interesting results were obtained by bending tests. The test strips were bent alternately in opposite directions till they broke. The strips were each clamped between a steam hammer and its anvil, and the projecting end was bent down by hammering (over a mold with round angle) through an angle of 45 degrees. The test strip was then turned over and bent in the opposite direction. Briefly, it was found that while a test strip bent cold would stand twenty to twenty-six bendings before cracking, if it was once bent while at the blue heat and allowed to cool, it broke afterwards with very few bendings.

SUMMARY OF TESTS BY C. E. STROMEYER.

	Average No. of Bendings Before Cracking.		
Conditions to which the Strip had been Brought.	Medium-hard Steel. ⅝ inch.	Mild Steel. ⅝ inch.	Very Mild Steel. ⅝ inch.
Unprepared or annealed	21	12½	26
Bendings while at blue heat	2½	1½	2½
Bent at blue heat once and cooled	3	2	11
Bent at blue heat twice and cooled	⅛	⅛	⅝
Bent once cold	20	9½	....
Bent twice cold	19½	8½	19
Bent four times cold	....	....	13
Bent eight times cold	....	....	15

Tests by Mr. F. W. Webb of the London & North Western Railway were also quoted in support of the same principle.

A common test used by boilermakers abroad is to cease work as soon as a plate which has been red hot becomes so cool that the mark produced by rubbing a hammer handle or other piece of wood over it will not glow. A plate which is not hot enough to produce this effect, yet too hot to be touched by hand, is probably blue hot, and should, under no circumstances, be hammered or bent.

Mr. H. D. Gordon, formerly Master Mechanic of the Pennsylvania at Juanita, gave his opinion very clearly on the danger of working at blue heat, and strongly favored the use of forging presses. What he says about the press is particularly important.

"Notwithstanding all that has been said and written on this subject, I believe it is one that is not generally well enough understood by boiler shop foremen and those having to do with the flanging of sheets. Hand flanging at best is a slow and laborious operation, especially when the heats are taken in the usual method and with an open fire. A small portion only of the sheet can be heated at one time, and the tendency is with the man managing the work to try to get as much of the sheet flanged at each heat as possible. Consequently it is often hammered at a much lower heat than it should be and with undoubtedly injurious effects to the sheet. Many of our mysterious cracks that are found in the flanges of boilers are no doubt due to this cause. The ideal way, undoubtedly, for flanging a sheet is by the use of hydraulic flanging presses. It is now about ten years since the Pennsylvania Railroad erected their new shops at Altoona for building locomotives, and at that time they put in a hydraulic press and complete plant for the flanging of boiler sheets by power at one operation, or, at most, two for each sheet, and as I had charge of the installation and operation of that plant, I had a chance to learn considerable about this method of flanging, and am convinced that it is the only proper way and should be more generally introduced. At the time the machinery was purchased there had not been a great deal of that kind of work done in this country, especially in locomotive boiler shops, and it was a difficult matter to get information as to what was required. We were obliged to depend largely upon the manufacturers of the press, which, by the way, was made in England. A very fine furnace was designed, which proved to be a complete success, and that is a very necessary auxiliary to a good flanging machine. That particular press did good work, and is still doing it, and I am sure that any master mechanic or those having to do with a boiler shop who once handled sheets flanged by that method would never want to go back to the old way of flanging by hand. Of course it is not possible for small roads with a limited number of engines to consider the installing of such a complete plant, but it is a question whether the large systems with a great number of engines and boilers could not profitably take up this matter with a view of installing at least one complete plant. There are machines made called sectional flangers which do not require such a large outlay for dies and which are a very great improvement on the method of flanging by hand. A combination of both will sometimes enable a very difficult sheet to be flanged in a very satisfactory manner. I think that every shop of any importance should at least have a large furnace in which the sheets can be thoroughly heated all over and annealed, and which would no doubt remove some of the bad effects due to improper working at low heats by the hand method. It was not long after the installation of that plant before the largest locomotive works in the country followed by introducing flanging presses, and they were generally much heavier and larger, and I think that it is quite common practice with them now to flange at least all of the plain sheets of their boilers."

Mr. T. R. Browne, Master Mechanic, Pennsylvania, who is now in charge of the Juniata shops, contributed the following to the same discussion:

The high grade and peculiar character of firebox steel necessitates more or less peculiar handling to produce the best results, and it is a pretty well recognized fact that to attempt to work this steel for the purpose of scarfing at a heat too low is to encourage cracks and a change of its structure, which will make it entirely too brittle either for safety or for long service. A low, red heat, and the work of scarfing completed while this heat lasts, or at least before it reaches a blue point, is generally the safest. I have known of cases where the location of the anvil at a point where a severe draft, incidental to adjoining doors or openings in the shop, had been the direct cause of cracking of sheets which were being scarfed over this anvil; and that, with pieces cut from the same sheet which had been spoiled, due to the cause stated, a test made at other points in the shop where there was an absence of these drafts, there was no difficulty whatever in securing the very best results.

As to the question of flanging by machine, as compared with the hand process, the advantages are almost too obvious to need comment. The question of great reduction in cost and absolute interchangeability of the parts, the even and thoroughly distributed stress on the material, as compared with the very best results of hand flanging, place this method far in advance of any other known at this time. All of the sheets, however, should be thoroughly annealed, and it is generally sufficient to allow them to cool with the last bent of flanging to secure an amount of annealing which will thoroughly remove all serious internal stress.

FRICTION LOSSES OF LOCOMOTIVES.

The friction losses of locomotives have been investigated by Prof. Goss by aid of the laboratory locomotive at Purdue University, and the records are to be found in an article by him in the Purdue University "Exponent." The friction losses were found to be variable on account of changes in cut-off and speed. The highest value of the loss by friction in proportion to the indicated horse-power of the engine was 23.3 per cent., corresponding to a speed of 55 miles per hour at 6-inch cut-off. The lowest value was 5.5 per cent, and was obtained at a speed of 25 miles per hour and at 10-inch cut-off. The friction loss decreases with an increase in cut-off. That is, for the development of a given amount of power, the more uniform the effort on the cranks the smaller the friction. This fact was confirmed by a test at 15 miles per hour, cut-off 20 inches, initial pressure in the cylinder 81 pounds, in which the loss in draw-bar pull was only 142 pounds. Within the limits of the experiments the loss does not change with the boiler pressure. For any cut-off the horse-power absorbed by engine friction is directly proportional to the speed. For any cut-off the higher the speed the greater the proportion of power absorbed by engine friction. This is due to the fact that the horse-power absorbed by friction is, and the indicated horse-power is not directly proportional to the speed. Prof. Goss says: "In the light of the data it would seem that under usual working conditions there is a loss in draw-bar pull, due to engine friction, of about 500 pounds. With the locomotive running at 50 miles per hour this corresponds to 67 horse-power."

SUGGESTIONS FOR RUNNING VAUCLAIN COMPOUND LOCOMOTIVES.

While the proper use of the starting value of a Vauclain compound locomotive is simple and easily understood, we have noticed, on several roads, a tendency to neglect this important part of their management. In our December, 1898, issue, page 403, we illustrated a device designed and constructed by the mechanical department of the Philadelphia & Reading Ry. for the purpose of preventing the practice of leaving the starting valve open, except when it was necessary in starting or in pulling over a summit. The following is taken from a little book entitled "Locomotive Data," recently issued by the Baldwin Locomotive Works, and in addition to outlining the proper method of starting a train, the suggestion as to the use of the starting valve in drifting should have attention from all who are using these engines:

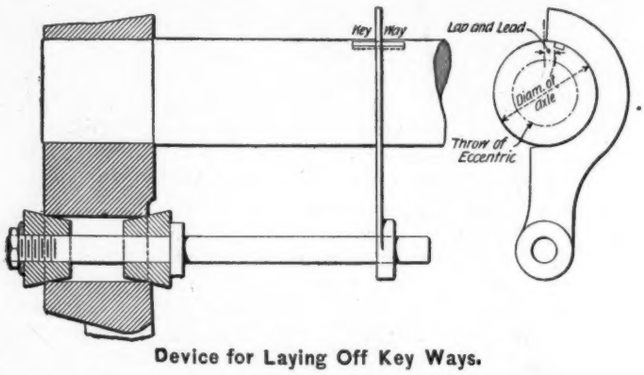
In starting the locomotive with a train, place the reverse-lever in full forward position, throw the cylinder-cock lever forward, which operation opens the starting valve, and allows live steam to pass to the low pressure cylinder. The throttle is then opened, and as soon as possible when the cylinders are free of water and the train is under good headway, the cylinder-cocks and starting valve should be closed. As the economy of a compound locomotive depends largely on its greater range of expansion, the engineer should bear in mind that in order to get the best results he must use his reverse-lever. After the starting valve is closed and as the speed of the train increases, the reverse lever should be hooked back a few notches at a time until the full power of the locomotive is developed. If after moving the reverse lever to the last notch, which cuts off the steam at about half-stroke in the high-pressure cylinder, it is found that the locomotive develops more power than is required, the throttle must be partially closed and the flow of steam to the cylinder reduced. In slightly descending grades the steam may be throttled very close, allowing just enough in the cylinders to keep the air valves closed.

If the descent is such as to prevent the use of steam, close the throttle and move the reverse lever gradually to the forward notch and move the starting valve lever to its full backward position. This allows the air to circulate either way through the starting valve from one side of the piston to the other, relieves the vacuum and prevents the oil from being blown out of the cylinder. On ascending grades with heavy loads, as the speed decreases the reverse lever should be moved forward sufficiently to keep up the required speed. If, after the reverse lever is placed in the full forward notch, the speed still decreases and there is danger of stalling, the starting valve may be used, admitting steam to the low-pressure cylinders. This should be done only in case of emergency, and the valve closed as soon as the difficulty is overcome.

DEVICE FOR LAYING OFF ECCENTRIC KEY-WAYS ON AXLES.

Baltimore & Ohio Railroad.

The simple and convenient device illustrated by the accompanying engraving is used on the Baltimore & Ohio for laying out the key-ways on driving axles, whereby the eccentrics are secured in position before the wheels are placed in position under the engine. The drawing makes the method of operation



Device for Laying Off Key Ways.

clear with very little description. The spindle which carries the two conical plugs is self centering in the crank pin hole in the driving wheel, and on the end of this spindle is an arm which partially encircles the axle. From this the key-ways are laid off with the proper angular advance. This device has been used for several years with very satisfactory results.

THE BUHOUP THREE STEM COUPLER.

The Buhoup Three Stem Coupler, manufactured by the McConway & Torley Co., was put through a series of severe tests at the recent convention at Old Point Comfort, in order to try its operation in taking severe curves. The results are given in the "Railway Age." The couplers were fitted to a Union Pacific pressed steel car of 90,000 pounds capacity and a P., C., C. & St. L. coal car of 80,000 pounds. They were tried on two curves, one said to be 58 and the other 76 degrees, and the cars were coupled and uncoupled easily on them. The strong claims made for this coupler and method of attachment are based upon the flexibility of the whole arrangement, whereby the natural movements of the couplers in taking curves may be accommodated without placing the cars or the couplers under unnecessary stress. The coupler head being attached to the coupler by a swivel joint, is able to yield to lateral movements, and in addition to this, the three stem arrangement with the three coupler springs permits of increasing the spring resistance of the coupler to prevent the springs from being closed up solid in hauling heavy loads. The three stems are not at all likely to break at once, no matter what the stress, and herein is a safeguard against the form of accident due to the falling of broken couplers on the track. These couplers have been in use for four years and the experience gained has shown the desirability of urging their use on freight equipment also.

Twenty consolidation locomotives, with Wootten boilers and 21 by 28-inch cylinders, have been ordered by the Erie from the Brooks Locomotive Works.

EXTENDED PISTON RODS.

"What advantages are gained by the use of piston rods extended through the front cylinder head?" was one of the topical discussions at the Master Mechanics' Convention, and the following is taken from the discussion:

Mr. R. H. Soule of the Baldwin Locomotive Works opened the discussion as follows:

"This question of the benefits, if any, following the introduction of extended piston rods or tail rods, is one of those questions which is now coming to the front as one of the natural sequences of the great increase in the size of our locomotives. There is little fixed opinion on the subject, among the railroad men, and no unanimity of opinion among the locomotive builders. I know of one road, the New York Central, which makes it a rule that all cylinders, 19 inches and upwards in diameter, shall have the piston rods carried through the front ends. I heard from a locomotive builder who does not consider it necessary to supply the piston rod extension unless the cylinder is 28 inches in diameter or upwards; there is a wide difference of opinion on this subject. As regards the mechanism by which the piston rod extension shall be supported in cases where it passes through the front end, there is no settled practice. It seems to be difficult to get a bushing or support more than 5 inches in length if you insist on having the piston rod extension in the bushing at all times. If you are willing to have the piston rod extension draw nearly out of the bushing on the back stroke, you can increase the bushing to 9 inches. When these extensions were first introduced into service they did not carry a good service record, because in the early cases they were not lubricated. The question of lubrication comes up, and one locomotive builder states it to be the practice where the extension is applied to always apply a triple sight-feed lubricator. One sight-feed lubricator being devoted to the usual purposes and the two branches of the third going to the bushing or front end cylinders for the lubrication of the piston rod extension. Another locomotive builder states this to be unnecessary, and that the successful lubrication of this piston rod extension only requires some nice work in the arrangement of lubricating grooves in the bushing, so that the steam which is supposed to be supplied with its own lubricant can reach the bearings in question. Among the locomotive builders it is felt that the piston rod extension in some approved form, when the practice has reached a final stage, where it commends itself to the railroads, will be a necessary feature in all future powerful locomotives; but there are a number of details to be worked out, and I do not think it can be said yet that any device which has been put out is an absolute success. One of the legitimate questions in connection with this problem of extended piston rods is whether the increased clearance which necessarily follows its use is not detrimental to the economy of the engine. We will take it for granted that extension piston rods are operated in closed tubes or pockets attached to the cylinder head, although it is entirely possible to make an arrangement by which the extension rod shall pass through a stuffing box; but under the present conditions the usual practice is to use the pockets for the rod to work in, and that necessarily increases the clearance at the front end of the cylinder. I have no information on that point, but it is a legitimate question whether that increased clearance would not impair the efficiency of the locomotive."

Mr. T. R. Browne, Master Mechanic, Pennsylvania Railroad, stated that he did not think it necessary to have the extended rod on an ordinary cylinder. Continuing, he said:

"We had an engine with 24-inch cylinders, solid heads, with a lining of block tin around the head. After a while they wore away and the crosshead began to show trouble. The crosshead also had block tin on top and bottom of the wearing surfaces, between the guides and the front end of the crosshead, and it would wear on the bottom of the back and on the top of the front end; and whenever you went by the engine, after she was running a little while, it looked as if the guides were out of line. The piston wore at the bottom and the crosshead went down with it. We took the crosshead out occasionally and relined it and put it in again in good condition, and we turned the piston around to let it wear on the other side, but the same trouble would take place. Finally, we decided to put an extension rod on, and after we did so there was no further trouble. We demonstrated on the 24-inch piston that the extended rod was a benefit."

Mr. A. L. Humphrey (Colorado Midland)—"So far as the question of extended piston rods on engines that drift a great deal is concerned, I think that is beyond experiment. As it applies to our road I know that with large engines with 20 and 21-inch cylinders, where they drift at times 100 miles at a stretch, it is necessary to have the extended rods in order to keep the cylinders from wearing. I am inclined to think that the stuffing box principle is a good one. We are not troubled with the question of lubrication. Our engines have 180 pounds pressure and we simply use the lubrication from the cylinder, nothing else, and we have experienced no trouble, except, of course, to turn the bushings often enough to keep them as nearly central as possible. We turn the bushings every 60 days."

Mr. C. H. Quereau, Master Mechanic of the Denver & Rio Grande, said:

"The road with which I am connected has a number of locomotives with the extended piston rods, but it is true that our engines are drifting half the time. We now have in service a design in which the bearing is 8½ inches, and adjusted perpendicularly, so that as the piston rod wears, we can raise the piston to the center of the cylinder. I think that the best device along this line is in use on the Atchison, Topeka & Santa Fe road, in which they have a long bearing similar to the one I have just mentioned, and just ahead of that they have a packing gland. One difficulty with ours, which is simply a brass bearing, and a sleeve over the extension piston rod, is in the matter of lubrication. We have on most of the engines a lubricating cup, a cup in which the oil is placed the same as on the lubricator itself, except that there is no sight feed. It will hold possibly a quarter of a pint; and we find the first time the locomotive throttle is closed the oil is drained out of this lubricator cup. With the device used by the Santa Fe road they have a perfect means of lubrication as much as you have on the piston rods at the back ends of the piston."

M.r J. E. Sague, Mechanical Engineer of the Schenectady Locomotive Works, contributed the following:

"Our first effort was with a brass bushing 5 inches in length. That did not seem to be enough, and the wear of the bushing was excessive. We now extend the length of the bushing to 9 or 10 inches. We put an auxiliary sight feed in the cup where the extended piston rod is used. We do not feel by any means that it is an absolute necessity, from the fact that we build more engines with extended piston rods in which the auxiliary lubricator is not used than in which it is used. It may be of advantage where the engines do a great deal of drifting. We apply the extended piston rods to all compound locomotives, and I am now applying the auxiliary lubricator to such engines as do a great deal of drifting. Our experience has been most satisfactory with extended piston rods."

The elements of safe operation of fast trains on a single track road were admirably summed up before the St. Louis Railway Club recently by Mr. W. A. Garrett, Division Superintendent of the Wabash Railroad, in the following terse language, which applies equally well to roads with more than a single track: "Requirements—Good road bed and bridges; reliable motive power and equipment; officials with loyal support; sober, capable, intelligent, quick-thinking and emergency-acting employees in all departments, thoroughly organized, interested in performance of duty and disciplined from the following recipe, which I can recommend fully: 'One-half kindness, the other half firmness.'"

COLOR-WEAKNESS AND COLOR-BLINDNESS.

It is important that tests for color-blindness for railroad men should establish beyond question the ability to distinguish colors, not only when atmospheric conditions are favorable, but when they are unfavorable. It is also important that the tests should be fair to the candidates. These considerations entitle the investigations of Prof. E. W. Scripture of Yale University, on this subject, to the careful attention of railroad officers. He presents his views in a contribution to "Science" as follows:

It is generally accepted as a well established fact that the traveling public is fully protected by the present tests for color-blindness to which railway employees and pilots are subjected. Yet several of the mysterious accidents that have occurred during the last two years might be explained on the supposition of color-blindness on the part of responsible lookouts. In fact, I believe myself in position to prove that persons of dangerously defective color-vision actually do pass the regular tests and obtain positions where their defects are continual dangers to public welfare. In the first place, I have at the present time among my students one who is absolutely perfect at the wool-test. He can match wools with incredible precision at any distance away; he is, nevertheless, color-blind. This case is typical of a class of persons with eyes abnormally acute for differences in color, but yet with only two fundamental sensations instead of three.

In the second place, I have had among my students those who possessed perfect color-vision for near objects or bright objects, but who were practically color-blind for weakly illuminated or distant objects. These persons possess the typical three fundamental color sensations, but have one of them weaker than the normal. A person of this kind may pass the wool-test with the utmost perfection if the test is performed close by, but will fail if the wools are removed to a distance of 20 or 30 feet. This peculiar defect I take the liberty of terming "color-weakness." The first student of this kind that I examined passed the wool-test close at hand and yet was unable to distinguish red and green lanterns a few hundred yards away. Cases similar to this have been reported by the British Marine Examiner, Eldridge-Green. Among other cases he quotes a letter from an engineer containing the following statement: "I have been on the railway for thirty years and I can tell you the card-tests and wool-tests are not a bit of good. Why, sir, I had a mate that passed them all, but we had to pitch into another train over it. He couldn't tell a red from a green light at night in a bit of a fog."

To eliminate both these classes of persons we must have a method of testing on quite different principles from the usual ones. In the first place, the sorting of delicate shades of colors, according to likeness, must be replaced by naming certain fundamental and familiar colors. The sorting of wools is a quite unusual task and perplexing task to a man brought up in a railway yard and on shipboard. It puts a nervous man at quite a disadvantage; it furnishes the unsuccessful candidate with the excuse that the judgment required was so unlike any he had made before that he failed from nervousness; and, finally, it is not a guarantee that all who pass are not color-blind. The naming of colors should—as Donders proposed—be rigidly required. The engineer or the pilot in his daily routine is not called upon to match colors, but to decide whether a light is red, green or white; he should be tested on just this point. The color-blind student referred to above who can pass the wool-test to perfection, fails at once when called upon to name the wools. The naming of delicate and perhaps unusual shades should, however, not be required; the colors to be named should be the three familiar ones: red, green and white, so manipulated that every possible chance for confusion is presented.

The second necessity for eliminating danger is that of an absolutely certain test which shall detect both the color-blind and the color-weak. Acting on the basis of suggestions from the work of Donders and of Eldridge-Green, I have devised a test that meets this requirement as well as the first one.

The instrument may be termed the "color-sight tester," or the "color-sense tester." In general appearance it resembles an ophthalmoscope. On the side toward the person tested, Fig. 1, there are three windows of glass, numbered 1, 2 and 3, respectively. The opposite side of the tester, Fig. 2, consists of a movable disk carrying twelve glasses of different colors. As this disk is turned by the finger of the operator the various colors appear behind the three windows. At each movement of the disk the subject calls off the colors seen at the windows. The windows, 1, 2 and 3, are, however, fitted with gray glasses. No. 1 carries a very dark smoked glass; all colors seen through it will be dark. No. 2 carries a piece of ground glass, showing all colors in full brightness. No. 3 carries a light smoked glass. There are thus thirty-six possible combinations of the colors. The twelve glasses are, however, mainly reds, greens and grays.

A suitable arrangement of the colors gives direct simultaneous comparisons of reds, greens and grays of different shades. The well-known confusion by color-blind persons of dark greens with reds, greens with gray, etc., are exactly imitated, and the instrument gives a decisive test for color-blindness. Its peculiar advantage, however, lies in the fact that it presents reds, greens and grays simultaneously in a large number of different shades of intensity. The light of a green lantern, at different distances or in a fog, is simulated by the green behind the different grays; at the same time a white light is also changed. The color-weak

Fig. 1. Fig. 2.

person to whom weak green is the same as gray (white at a distance) is utterly confused and thinks that the weakened green is gray (white) and the dark gray is green.

The actual test is performed in the following manner: The tester is held toward a window, at about 2½ feet from the person tested. The operator begins with any chance position of the glasses, and asks the person tested to tell the colors seen through the three glasses, Nos. 1, 2 and 3. He answers, for example: "No. 1 is dark red; No. 2 is gray; No. 3 is green." The operator records from the back of the tester the letters indicating what glasses were actually used. If he finds that A, D and G were opposite the glasses Nos. 1, 2 and 3 he records: A 1, dark red; D 2, gray; G 3, green. The disk is then turned to some other position; the colors are again named, and the operator records the names used. For example, the result might be: "No. 1 is dark green; No. 2 is white; No. 3 is red;" and the record would read: G 1, dark green; J 2, white; A 3, red. Still another record might give: J 1, dark gray; A 2, red; D 3, medium gray. Similar records are made for all combinations. Of course, the person tested knows nothing concerning the records made. A comparison with a list of the true colors for each position determines whether the test has been passed or not.

The three records just cited were all obtained from the red

glass, A; the gray glass, D; the green glass, G, and the ground glass, J, in combination with dark gray, No. 1; the ground glass, No. 2, and the medium gray, No. 3. Those familiar with color-blindness will notice that these combinations place side by side the colors most confused.

The records can be taken by anyone, and, on the supposition that the record has been honestly obtained and that the instrument has not been tampered with after leaving the central office, the comparison is mechanical. There is none of the skillful manipulation required in the wool-test and none of the uncertainty attaching to its results. The only instruction given to the subject is: "Name the colors;" the results render the decision with mechanical certainty.

One of the testers is in use on one of the English railways, another on the central division of the New York Central Railroad. From the former I have not yet heard, but the examiner on the latter reports that since using the tester he has found men who get through the wool-test, but are caught by the tester. On the other hand, he states that "the men examined say that this test is more like the signals they are used to seeing every day on the road, and is, therefore, fairer than to ask them to pick out a lot of delicately tinted pieces of yarn."

An experience of several years seems to justify the following claims for the color-sense tester:

1. It detects with unerring precision both the color-blind and the color-weak.
2. It is a perfectly fair test for the men concerned and injures no man by requiring an unfamiliar judgment.
3. It requires but a very small fraction of the time used on the wool-test.
4. Its decisions are self-evident and unquestionable.

THE AUTOMATIC ELECTRIC FEED WATER PURIFIER.

This is an interesting and apparently very successful type of feed water purifier, which adds no complication to the working parts of a steam plant and simply forms a part of the feed pipe between the pump or the injector and the boiler. Mr. Samuel M. Green, Mechanical Engineer of the American Thread Company, in discussing the paper by Mr. Howard Stillman, Engineer of Tests of the Southern Pacific Railway, on "A Water Purifying Plant," before the American Society of Mechanical Engineers (Proc. A. S. M. E., Vol. XIX, page 437), spoke as follows:

"In a battery of Manning boilers of about 600 horse-power at the mills of the Merrick Thread Company, Holyoke, Mass., we have had a great deal of trouble from scale forming upon the tubes, and then dropping down upon the crown sheet. Many kinds of scale resolvent have been tried, including soda ash, kerosine and crude oil, but it has been found almost impossible to keep the tubes from leaking. About three years ago (this was said in December, 1897) an electro purifier was brought to my attention. It consisted of a series of copper and zinc plates placed in an upright pipe. The feed water is passed up through this pipe and comes in contact with the zinc and copper plates. It was found necessary to keep the temperature at above 170 degrees. When putting in this purifier I did so with a great deal of misgiving, but it has since proved itself reliable. I do not think that its action upon the scale forming properties in the water has been explained, but the fact remains that our boilers have been free from scale since its installation. The scale, instead of forming hard upon the boiler surfaces, is deposited in the shape of mud, which is blown out every day. The zinc plates are renewed once a year, at a cost of about 10 cents per horse-power. I have put this purifier upon several plants, in one case particularly where the water was from an artesian well. In this plant as soon as the purifier ceases to act the boiler immediately becomes coated with scale. As long as the zinc plates are active the boiler is kept clean."

Prof. R. H. Thurston, in the same discussion, offered the following in explanation of the operation of these devices:

"It seems, for some reason which I do not quite understand, to prevent the sulphate of lime coming down in the form of hard scale. It is still sulphate of lime, but it does not cover the heating surface with incrustation; it is not hard as marble, or harder, as is often the ordinary scale, and it is easily washed out."

The probable explanation of its operation is that the presence of the electric current generated by this device in the presence of the warm feed water prevents the crystallization of the scale and thus robs it of its power to become firmly attached to the heating surfaces. It does not prevent the precipitation, but changes the character of the precipitate so that it does not adhere to the tubes and sheets. It does not appear to act in the same way with all feed waters, but with the waters to which it is adaptable it works well. In a recent letter to us Mr. Green says that in most cases he has had very satisfactory results.

This purifier is manufactured by the Curtis-Hull Manufacturing Company, 42 Union Place, Hartford, Conn. It seems to be particularly well adapted to use on locomotives, and as its application involves no undesirable complication, it is hoped that trials will be made with it in that service.

LONG LOCOMOTIVE RUNS.

Baltimore & Ohio Railroad.

The experiment of almost doubling the runs of the passenger engines of the Baltimore & Ohio has proved more successful than its warmest advocate had any idea that it would. For a great many years the average run on the Baltimore & Ohio was 125 and 150 miles, and it was supposed that on account of the heavy grades one locomotive could not be used for a continuous run of 200 or 225 miles. However, General Manager Underwood and Mr. Harvey Middleton, Mechanical Superintendent, determined to make the experiment, and during the past three months have demonstrated that these continuous runs are not only successful but economical, even on the Baltimore & Ohio, where 1, 2 and 2½ per cent. grades are found. Passenger engines are now run continuously from Cumberland to Parkersburg, a distance of 207 miles, and from Cumberland to Wheeling, 201 miles. From Cumberland to Parkersburg the engines go out on trains 1, 3 and 55, returning on trains 2, 4 and 12. From Cumberland to Benwood the run is 200 miles, and the engines go out on train 7, returning on train 46. This change has enabled the road to reduce the number of engines in that service from 24 to 12, and has doubled the mileage of each engine when run from Philadelphia to Washington, Washington to Cumberland and from Cumberland to the Ohio River. Each locomotive will average very nearly 7,500 miles per month.

West of the Ohio River three engines are used to haul trains 7, 8, 46 and 47 between Benwood and Chicago Junction, a distance of 190 miles, and they will average about 7,680 miles a month. These engines are double crewed. Four engines at present are running trains 103, 104, 105 and 106 between Benwood and Cincinnati, a distance of 254 miles, running through westbound and are relieved at Newark eastbound. These engines are also double crewed and they will average a monthly mileage of 7,650 miles. Trains 3 and 4, between Newark and Sandusky, and local passenger trains between Newark and Shawnee are run by two engines and three enginemen, the distance being 159 miles. These engines will make an average mileage of about 5,742 miles per month. Trains 16, 17, 114 and 115, running between Columbus and Sandusky, a distance of about 149 miles, are run by one engine, double crewed, with a monthly mileage of about 8,012 miles. Trains 101, 102, 107, 108, 111 and 112, between Cambridge and Cincinnati, a distance of 201 miles, are handled by three engines and five enginemen, with a monthly average mileage per engine of 6,443 miles. It is estimated that under the new method the enginemen make about the same wages with less work. They average about 3,800 miles per month each, and under the system west of the Ohio River the saving is equally as great as has been east of the river, as it now takes 13 locomotives to handle the trains, while formerly 25 were required, it being a net decrease of 12 locomotives.

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J. S. BONSALL, Business Manager.

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G. M. BASFORD, Editor.

AUGUST, 1899.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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In this issue some reasons are given why condensers should be applied to stationary engines in railroad and other shops. They may be used so easily, and when once installed give so little trouble that when once considered as a necessary part of a steam plant they will come into such general use as to make an exhaust pipe discharging steam an unusual and noteworthy matter. Many motive power men and engineers spare no effort to prevent a few pounds of steam from being wasted at pop valves and are not stirred at all by the loss of tons of it through exhaust pipes. This is just as wasteful in principle and more worthy of attention. The advantages of condensers are probably appreciated, but the fact that any one may use them is not generally understood. Any one may put in a cooling tower and thereby use the condensing water over and over again. Some people have not thought of using them, because exhaust steam is required for heating. There are very few cases where the cost of condensers and cooling towers will not be saved in a year or probably two years, and it is seldom that all of the exhaust is needed for heating. A large proportion of the time none is needed, and the full advantages of the condenser will be available at least three-quarters of the time, even in comparatively cold climates. Where coal costs two and three dollars a ton there is no question of the profit to be had by condensers, and it will pay to put them in where the price is much lower than that. The cost of the apparatus is low, the return large and immediate and the idea is simple. Many shop engines are being loaded more and more every year until they are overloaded. This is a good way to make the old engine answer the purpose a little longer. We wish space permitted the reproduction of a paper read some time ago before the American Society of Mechanical Engineers by Mr. J. H. Vail, which gives an account of the installation of a condenser and cooling tower. In this case the capacity of the plant of 28 boilers 48 inches in diameter and 20 feet long was increased by 1,000 horse-power without changing the plant or adding boilers or engines.

The "few well tried forms" of locomotives made in this country, and mentioned elsewhere in this issue in a communication from Consul Monaghan, seem to be the basis for a vast deal of misunderstanding abroad, but foreigners who want locomotives at relatively low prices and quick deliveries are looking in this direction as they never have before. Everyone who understands locomotive building in this country knows that our builders do not "always build from a few sets of patterns, castings for which are always carried in stock." It does no harm, however, for foreigners to believe that this is done, so long as they know that they may obtain good locomotives here on short notice. It is this feature of American locomotive building practice that ought to be most vigorously taught abroad at this time, namely: That we build good locomotives and build them rapidly; further than this, they may be exactly duplicated on subsequent orders. We cannot hope to compete with German builders for their home trade because of the willingness in that country to use excessive complication, but we probably shall be able to fill many of the orders now received by the German builders for other countries where our simplicity of construction will count favorably. American builders are probably not blind to the situation described by Consul Monaghan, and the present opportunity is one which they will not neglect. A long story concerning locomotive practice is told in the statement that 18 German locomotive building shops can turn out but 1,400 locomotives per year. Opinions of our locomotive practice are changing in England, as may be seen by the quotations presented elsewhere in this issue from an editorial in "The Engineer," of London.

The importance of the working of boiler sheets in flanging at temperatures above the "blue heat" does not appear to be generally appreciated, although it has been known for years that steel worked too cold receives permanent injury which is likely to cause it to fail under stresses that are far below its normal strength. This was one of many valuable points brought up for discussion by Professor Hibbard's paper on locomotive boilers, recently read before the New York Railroad Club, and it will pay those who make or repair boilers of any type to examine their practice in this regard. Flanging is a difficult operation, especially when performed by hand without the aid of special formers. The work is naturally slow and the tendency to use as few heats as possible is strong. The result of this is to work the sheets as long as possible after each heat and frequently the temperature falls until the metal receives permanent injury, even before it has been put in place in the boiler. The ideal method of forming and flanging boiler plates is to use large furnaces, heating the entire sheet at once and then, by the use of hydraulic presses and dies to press the sheet into the desired form at a single operation. This, of course, requires a large outlay for special machinery and dies, which small establishments can not afford. The smaller sectional hydraulic flanging presses are available, however, and large dies are not needed with these. The work is not as rapid as with the large presses

and the danger of working at the blue heat is greater. A satisfactory rule for judging of the temperature below which the work should not be done is to rub a piece of wood over the surface of the plate, and if it does not leave a red glowing path the sheet is too cold and the work should stop. The necessity for increased care in this connection is more apparent with the increase in steam pressures, and by insisting upon this simple rule in the boiler shop a great deal of anxiety may be avoided. The "blue heat" occurs between temperatures of 550 and 700 degrees and is below the temperature at which iron will show a red glow in the dark. Its most prominent effect seems to be to reduce the ability of steel to resist repeated bendings and the life of modern locomotive boilers depends very largely upon this quality. A sheet which has undergone this treatment will withstand only about one-third as many bendings as before.

The remarkable progress which gas and gasoline engines are making is a natural result of education in regard to their advantages. The best of steam engines used for ordinary work consume about 2 pounds of coal per horse-power hour and from 6 to 12 pounds more nearly represents common practice with small steam engines. The cost of attendance for a steam plant is very high and proportionately higher per horse-power as the size of the engine decreases. A steam boiler requires constant nursing, frequent cleaning, scaling and overhauling, and also these expenses are constant, even if the engine is used but a few hours each day. The internal combustion engine presents an agreeable contrast to all this. It starts easily and quickly, and when once started it needs only to be oiled and properly loaded to work along unattended all day long. The fuel consumption is proportional to the load, and when the engine stops all expense stops also. As to the relative cost of operation, it may be confidently accepted that a gasoline engine will cost not more than half as much to run as a steam engine of equal power. The time has come for the gas engine to receive careful consideration by all who contemplate enlarging or remodeling old shops, and especially by those who are planning new ones. The new Westinghouse works for the manufacture of air brakes in Russia are to be driven entirely by gas engines. Why should they not be used for driving the machinery of railroad shops? They offer a most satisfactory method of distributing power and there are many designs that are quite ready for important responsibilities.

Piston valves are regarded by many as the coming valves for locomotives. The advantages they offer are the possibility of perfect balancing and shorter as well as more direct steam ports with reduction of clearance. The port openings of piston valves may also be much larger than those of flat valves for the same valve travel. Some of the best arguments in favor of this type of valves were offered in connection with the records of the performance of the Atlantic City locomotive of the Philadelphia & Reading Railway by Mr. Vauclain, and this is regarded as the strongest support that the piston valve has had. That valves of the piston type are not necessarily perfectly balanced merely because they belong to that type is conclusively shown by Mr. F. M. Whyte, on page 199 of our June issue. Mr. Whyte's table of the pressures of the packing rings against the casings is evidence enough that the form and size of the rings are exceedingly important. We know of one case in which the width of the rings in locomotive valves of this type were at first about ½-inch and having been gradually reduced to about ⅛-inch and then, owing to the rapid wear of the rings, they were discarded altogether and the valves were made in the form of plain cast-iron plugs without rings. In this a leaf has been taken from steam pump practice and it is said that the results are quite satisfactory. In using plug valves it will be necessary to provide for equal expansion of the valve and the casing and it will also be necessary to guard against the possibility of drawing smoke and cinders into the steam chests from the smoke box. Of this we shall have more to say at another time.

Professor Scripture's tests for color-blindness and what he terms "color-weakness," as described on another page of this issue, appear to be logical and altogether sensible. They are based upon the principle of reproducing as far as possible the conditions of the colors as they are actually seen through the various kinds of atmospheres found along railroads and surrounding terminals. Professor Scripture writes us remarking the interesting fact that numbers of men are rejected by the wool test who are merely nervous or unaccustomed to pay attention to colors. Considerable discussion has been going on in England as to the fairness of the skein test, and questions have frequently been raised in this country on the same point. We quote from a letter from Professor Scripture: "The examination with the tester (the one we illustrate) is absolutely fair; a friend of the person to be examined may stand by his side, see the test and pass or condemn the man with as absolute and indisputable certainty as the examiner. This is an important safeguard for both examiner and examined; the test is self-evident and unquestionable. The Holmgren test is so uncertain that any one armed with the color sense tester might undertake to examine side by side with one using the wool test and show that the latter passes men who are defective and rejects men who are of sound color vision." This statement is so strong and the subject is charged with such great interests as to command immediate attention.

AIR BRAKE DECISION, WESTINGHOUSE VS. NEW YORK.

Another decision in the litigation between the Westinghouse and the New York air brake companies was handed down by the United States Circuit Court of Appeals for the Second Circuit, July 18, at New York, the decision being in favor of the New York Air Brake Co., as noted elsewhere in this issue.

The Westinghouse Co. some time ago brought suit against the New York Co. for infringement of two patents on triple valves, claiming that the triple valve brought out by the New York people in 1895, whereby the train pipe was vented to the atmosphere in emergency applications, was an infringement of Westinghouse patents. The question at issue was the right of the defendants to use this triple valve which vented to the atmosphere, and the decision was in favor of the defendants. The suit just closed was on an appeal from the previous decision and was handed down by Judges Shipman, Thomas and Lacomb, Judge Lacomb dissenting with reference to the infringement of one of the patents.

The decision may, at first, appear to be a decisive victory for the New York and a serious defeat for the Westinghouse company. Technically it is this, but really it is a success of the defendants in a plea to be allowed to make and sell brake apparatus, the inferiority of which, in comparison with the highly perfected brake of the complainants, was urged as a strong defense of non-infringement.

The standpoint from which to view this case is that of the railroad man who appreciates the importance of the air brake in the safe operation of trains and knows that the safety of fast trains depends very largely upon the ability to stop them quickly; our readers are not so much interested in the ownership of the patent rights of the appliances by which this result is attained. The question of whether the railroads will get better brakes as a result of this decision is answered in the negative, and this should be the most important question to the railroad man. The defendants have certainly not been sustained in the right to manufacture and sell an improvement in air brakes.

The defendants some time ago attempted to use the best features of the Westinghouse brake and were restrained by the courts, and their plea in this case was for the privilege of using an inferior make-shift because of commercial reasons. Their position was plainly stated in the argument of their attorney before the lower court in the following language:

"We ask Your Honor to bear in mind that these defendants,

having been badly advised formerly and having been held by this court not to be able to build a valve which has the function and mode of operation of the valve and brake system that constituted Mr. Westinghouse's great inventions of 1886 and 1887, to-day have departed entirely from that valve and are building one which does not have the supreme feature of those inventions and one which is distinctly based on the prior art; but it is a valve which they are able to sell; it is a valve that some people in the community want, and they are entitled to the full and careful consideration of the court as to whether they are or are not violating anything that these complainants are entitled to monopolize."

"The Westinghouse system to-day has twenty per cent. more power in the brake cylinder for setting the brakes than does the defendant's system; or, as some of the witnesses have said, there is fifty pounds pressure to the square inch in the defendant's system and sixty pounds to the square inch in the complainant's system; and, may it please Your Honor, the addition of that 'giant force' was made without the slightest sacrifice that was material, in the matter of accelerating the action of each individual car, or brought about by venting at the next preceeding car. This is conceded."

"I ought to say perhaps that it appears in the record that by reason of the defendant's venting to the atmosphere we are able to set our brakes in a fifty-car train a quarter of a second earlier than the Westinghouse can; but what is the result? We get ten pounds less pressure in the brake cylinder; and Westinghouse sets his brakes fast enough, and we do not get all the pressure that we would like to have. The fact is . . . that these defendants have endeavored to infringe the Westinghouse patents and have been checked, properly checked and restrained by this court. They do not infringe these patents at the present time, because they have left out the substantial and important and most valuable feature of the Westinghouse air-brake system."

The effect of the decision on the air brake situation is the next question. There are several things to be considered in this connection. Air brake apparatus forms part of the permanent equipment of rolling stock and its deterioration is not like that of many other parts of the equipment that gives out all at once; it wears in such a way as to be restored by renewing comparatively small parts and the apparatus as a whole wears a long time, even perhaps outliving the structures on which it is carried. This is the reason why the most careful selection should be made in the first place. With most other apparatus about cars and locomotives mistakes may be easily remedied. Not so with brakes.

Interchange is the most vital question in car matters and it has occupied the attention of an association of bright men for thirty-three years; everybody knows the importance of interchangeability of air brakes and every one admits the vital character of this factor in train operation. Interchangeability has two sides, that of unison in operation and simplicity in the matter of repairs. The necessity for yard inspection and repairs is only just beginning to be appreciated, and unless there is good reason for making it necessary to carry several kinds of repair parts in stock, this trouble should be avoided. There is also the matter of instruction of the train and enginemen in the use of brakes. Even with the large number of instruction cars belonging to the railroads and to the air brake manufacturers it is difficult to attend to the necessary work of teaching the use and maintenance of brakes. These difficulties are multiplied by the introduction of different systems.

If a new brake is admitted to use in interchange there should be no question of its being at least equal to, if not better, than that which in point of numbers is entitled to be considered the standard. This distinction may be regarded as established when 860,000 sets of one kind are in use, or about 90 per cent. of the total number of brakes applied to the rolling stock of this country. This fact, on account of our practice in interchanging equipment, might be expected to make it difficult to introduce another system, even it were distinctly superior to the one so generally adopted. We have, however, never heard that any one has claimed that the triple valve of the defendants in this suit is superior to that of the complainants. Railroads have insisted upon the highest efficiency before all other considerations, and it is probable that they will continue to do so.

NOTES.

An immense steel rail order has been awarded to the Carnegie Steel Company for Prussian railroads. The total amount is stated to be 180,000 tons, which is the largest contract ever placed. It is to be completed in 26 months.

A good record for punctuality is reported for the fast mail on the Chicago & North Western. In 100 days the train was more than 10 minutes late only 11 times, these delays all being due to severe storms.

The importance of the steel car in the economy of railroad operation of this country is shown in an impressive way by the fact that in the month of June of this year the aggregate sales of these cars by the manufacturers amounted to one and one-quarter million dollars.

The North German Lloyd steamship "Kaiser Friederich" has been sent back to the builder, F. Schichaw, because of the failure to make her guaranteed speed of one-quarter knot per hour faster than the "Kaiser Wilhelm der Grosse." The Kaiser Friedrich" is the smaller ship of the two, but has more powerful engines than the record breaker.

At the Article Club Industrial Exhibition at the Crystal Palace, Muntz's Metal Company show a collection of almost every variety of copper and brass tubes, and included in this interesting exhibit is a tube which has been taken out of a set of hardened copper tubes with tempered ends, which have been in an express engine on one of the chief British railways for 18 years, during which period it has run 480,000 miles. It is stated that the copper is as good now as when the tube was first made, and that the loss from wear and tear is only 15%.

The record of automatic block signals on the Philadelphia & Reading, published recently by the "Railroad Gazette," is remarkable evidence of the reliability of this system. We quote the following from that journal: "Their number of failures from all causes, as compared with the total number of movements of each signal, does not exceed one in 30,000. This class of failures only causes a stoppage of the train till the cause can be ascertained. The failures which are entirely erroneous [which make a signal show safety when it ought to show danger] are less than one in a million movements, a far better result than can be obtained from any system of block signals dependent on human agencies."

The new Schenectady locomotives for the Vandalia have been making some phenomenal runs. The following record, having been received from one of the higher officers of the road, is authentic: The run was made with the Vandalia train No. 20. The train passed Clayton 8 minutes late; passed Transfer Station 1 minute late, the distance being 18 miles and the time 14 minutes, which gives 46 seconds to the mile for 18 miles, or 78 miles per hour. Part of the distance was made at somewhat higher speed. For instance, Cartersburg was passed 7 minutes late, and as stated Transfer Station 1 minute late. The distance, 14.93 miles, was made at 44 seconds per mile, or 82 miles per hour. The train consisted of 8 cars. There were two postal cars, one combination coach and baggage car, two day coaches, two sleepers and one dining car. The locomotive was recently built by the Schenectady Locomotive Works, and is No. 16. It is of the 8-wheel type with cylinders 20 by 26 inches, driving wheel 78 inches in diameter, weight on drivers 85,800 pounds, total heating surface 2,241 square feet and grate surface 30.07 square feet.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS OF SCRANTON, PA.

Correspondence Instruction.

The correspondence plan of education is one of the most important and far reaching methods of instruction to-day. It takes a high place because it fills a widespread, urgent need. It provides means for improving the minds and the condition of those who without it could have no educational advantages. It educates those whose need is greatest and whose appreciation is keenest. Correspondence instruction cannot take the place of class room and lecture course, but to those who can not go to technical schools it presents the possibility of securing knowledge by aid of a logical arrangement of subjects and a definite plan of work with all of the assistance that is to be had in such courses by correspondence. The two methods should not be compared, because they are intended for entirely different classes of students One class devotes several years to the school exclusively, while the other studies during the hours not occupied in the shop at the bench, running or firing locomotives, or in other forms of labor. The correspondence school is necessarily less thorough, but it has a decided advantage in the fact that its students know exactly what they want to study, and also because their purpose is fixed and firm. It has a philanthropic side in that the workers in low grades are assisted to raise themselves to higher ones. Its success depends chiefly upon the earnestness of the student, and one who is willing to work hard during the hours allotted to rest and recreation is likely to profit to the utmost from the advantages offered. The plan proves itself to be good by its success, and it should be supported by all railway officials who have charge of the work of young men by encouraging them to improve themselves in this way. Those who are struggling along and studying single handed are wasting time that may be saved by taking up a correspondence course, written by a specialist who devotes his entire attention to the preparation of the papers.

INTERNATIONAL CORRESPONDENCE SCHOOLS.
General Offices.

A representative of the American Engineer and Railroad Journal visited the International Correspondence Schools with a preconceived idea that the correspondence plan of education could not accomplish all that has been claimed for it, but a thorough examination of the aims and methods changed this opinion to the point of enthusiastic endorsement, and the same result must be reached by practical railroad men or manufacturers upon looking over the system carefully as it is carried out at these schools, which are largest and most successful example of schools of the correspondence plan.

The Scranton Schools.

We illustrate the main building of these schools because of its architectural beauty and its admirable appointments. The provisions for light and ventilation are specially noteworthy.

The institution had its origin in the correspondence columns of the "Colliery Engineer and Metal Miner," now published at the schools as "Mines and Minerals," by the Colliery Engineer Co., of which Mr. T. J. Foster is Manager.

The schools were started in 1891 as a result of the demand among miners for educational privileges necessary to enable them to pass the examination required by the mine laws. Mining was the first subject taught and by a single instructor, who made a study of the requirements of the applicants and adapted the instruction accordingly. Other subjects were added and the number of enrollments February 20, 1899, was 76,667; at present the number is over 90,000.

Courses of Instruction.

The student must be able to read and write. The courses are planned with great care and the instruction papers are presented in small installments in order to avoid discouraging the students. All students starting at the bottom are required to take elementary arithmetic. There are 57 separate courses, each of which is prepared in the form of pamphlets accompanied by sets of questions and answers. The pamphlets are prepared with special reference to the qualification of the students, their chief characteristic being clearness and simplicity of statement and illustration. The student answers the questions in instalments and the papers are examined, corrected and returned. The instruction papers are also furnished in bound volumes early in the courses, for permanent text books, which are indexed and may be used for reference. The student may copy the answers to all the questions, but this is not often done by those who are earnest enough eo engage in work of this kind. The mechanical drawing lessons cannot be copied, because the work is required to be done to a different scale from that used in the originals. Mechanical drawing is one of the most popular subjects, and the instruction book seems to be admirably adapted to its purpose. The papers are marked with evident care and the students ask whatever questions they desire. It is assumed by the writers of the courses that the student at first knows nothing about the subjects, and for this reason the instruction is not "over the heads" of the students.

Those who mark the papers in any course have taken that course themselves, and difficult and unusual questions are referred to the specialists, who write and revise the instruction papers. Those who desire may go as deeply into any of the subjects covered by his course as the correspondence plan will permit. No time is set for the completion of a course, but students are encouraged to progress constantly, even if slowly. A special department is provided for the benefit of the totally uneducated, as, for example, a miner who never had a chance to go to school and cannot add or subtract. There are such now enrolled and this part of the work touches philanthrophy.

The courses are not all above criticism, but the fact that they are unique in literature must be taken into consideration by the critic. The plan provides for frequent revision and improvement. The air brake instruction books are admirably written and the engravings are remarkable. The locomotive

and car courses are being revised and they will be greatly improved.

Diplomas are given at the completion of courses.

The Plant.

The organization and plant are extensive and interesting. There are departments for everything from the solicitation of students to the employment bureau and local office. There are about 1,000 employees, and in addition to the unique equipment at Scranton, representatives are traveling all over the country in three cars built especially for the purpose of exhibiting the work and explaining the advantages of the schools. The building and equipment at Scranton cost $250,000, and recently an entire city block, near by, has been purchased for the purpose of building a printing establishment sufficiently large to do all the printing for the schools. The home equipment is impressive, but there are as many employees "on the road" and connected with local offices as are employed at Scranton.

Students.

The average age of students at present is 25 years. They are in many cases ambitious young men, and many of them obtain free tuition by securing the enrollment of others. The expense is not great and a system of instalment payments is arranged. Every student's record is kept, in order to permit of reporting advancement to employers and to be used in recommending students for positions. Many employees in drafting rooms are enrolled, also apprentices in shops, firemen on locomotives, and even technical school graduates who desire to take up subjects not covered by them when at school or to brush up on subjects which they have studied. It would be a good plan to require all shop apprentices to take a correspondence course as a part of the requirements for admission to the shop, and the employer will be rewarded if he pays the tuition.

Publications.

In connection with the schools four periodicals are published, viz.: "Mechanic Arts Magazine," "Steam and Electric Magazine," "Building Trades Magazine," and "Mines and Minerals." The editors are in touch with the work of the schools and are available in consultation concerning the instructive work.

Officers.

The officers of the institution are: Mr. R. J. Foster, President; Mr. T. J. Foster, Manager and Treasurer, and Mr. E. H. Lawall, Vice-President. The schools are controlled by the Colliery Engineer Company, incorporated under the laws of Pennsylvania, with a paid up capital of $1,250,000. The manager, Mr. T. J. Foster, is the originator of the schools. To his management the success of the institution is due. He is also the pioneer in correspondence instruction, and while the schools are carried on because they "make money," the management is entitled to credit for building up a most useful and necessary institution.

It is bad practice to empty boilers under steam pressure, when they have to be cleaned, to remove the deposit adhering to the boiler plates. This is the usual method with stokers, but there are two great inconveniences connected with it. The internal surfaces of the boiler plates are exposed to radiation from the hot surrounding brickwork, and the deposit during the process of emptying adheres to them and cannot be removed except by hammering. In the second place the riveted joints, affected by the radiation, and no longer covered with water, soon have a tendency to leak. Boilers should never be emptied until the steam pressure has fallen to about 1 atmosphere, or even less, and should be allowed if possible to become quite cold. The process of cleaning them thus, by means of a hose and water-jets, after carefully drawing off the water, is due to Mr. Savreuse of Amiens. Since 1886 it has been used for many boilers in France, and they have always been found very clean inside afterward, the deposit comes away easily, and there is no necessity for chipping. To cool a boiler completely, when surrounded by brickwork, takes about 8 days altogether. After 3 days the flues can be cleared of the cinders and soot, and this helps to cool the water. A small steel scraper will be found useful to remove the harder deposit.—Inst. C. E. Foreign Abstracts.

PERSONALS.

Mr. T. E. Harwell has been appointed Master Mechanic of the Southern Railway at Mobile, Ala.

Mr. D. A. Williams has been appointed General Storekeeper of the Baltimore & Ohio, with headquarters in Baltimore.

Mr. R. W. Morgan has been appointed Purchasing Agent of the Wagner Palace Car Company, to succeed the late D. O. Talbot.

Mr. William C. Pennock, formerly Master Mechanic of the Southwest system of the Pennsylvania at Logansport, Ind., was drowned July 17.

Mr. David Van Alstine has been appointed Master Mechanic of the Chicago Great Western to succeed Mr. Tracy Lyon, who has been promoted.

Mr. A. Hendee has been appointed Master Mechanic of the Panama Railroad, with headquarters at Colon, Colombia, succeeding Mr. Percy Webb, resigned.

Mr. F. W. Main has been appointed Purchasing Agent of the New Orleans and Northwestern, with headquarters at Natchez, Miss., succeeding Mr. C. G. Vaughn.

Mr. Thomas Fielden has been appointed Assistant Master Mechanic of the Missouri Pacific, with headquarters at Cypress, Kan., to succeed Mr. W. T. New, resigned.

Mr. Steven A. Gardner, general Superintendent of the Marine Division of the New York, New Haven & Hartford Railroad, died suddenly, of apoplexy, on July 9.

Mr. W. H. Reilly has been appointed Master Mechanic of the Fort Worth & Rio Grande, with headquarters at Fort Worth, Tex., to succeed Mr. T. J. Shellhorn, resigned.

Mr. G. T. Sanderson has been appointed Master Mechanic of the Montana division of the Great Northern, to succeed Mr. J. McGie. His headquarters are at Havre, Mont.

Mr. H. F. Ball has been appointed Mechanical Engineer of the Lake Shore & Michigan Southern. He was formerly General Car Inspector and the position has been abolished.

Mr. J. McGie, Master Mechanic of the Montana Division of the Great Northern, has been made Master Mechanic of the Montana Central, a tributary line to the Great Northern.

Mr. J. W. Stokes has been appointed Master Mechanic of the Omaha, Kansas City & Eastern and Omaha & St. Louis, with headquarters at Stanberry, Mo., to succeed Mr. C. A. DeHaven.

Mr. M. J. Spaulding has been appointed Master Mechanic of the Washington County Railroad at Calais, Me. He was formerly Road Foreman of engines on the Atlantic Division of the Canadian Pacific.

Mr. George W. Taylor, formerly Master Mechanic of the Wisconsin & Michigan Railway, has been appointed Master Mechanic of the Copper Range Railroad, with headquarters at Houghton, Mich.

Mr. P. L. Cochrane, formerly Master Mechanic of the Central of Georgia at Columbus, Ga., and later Master Mechanic of the Seaboard Air Line, died at Atlanta, Ga., on July 4, at the age of seventy-one years.

Mr. Tracy Lyon, Master Mechanic of the Chicago, Great Western, has been appointed General Superintendent of that road, with headquarters at Saint Paul, Minn., in place of Mr. Raymond Du Puy, resigned.

Mr. I. Knapp, general foreman of the Buffalo shops of the Lehigh Valley, has been promoted to succeed Mr. J. S. Chambers as master mechanic.

Mr. H. K. Bates, Master Mechanic of the Fort Scott and Springfield divisions of the Kansas City, Fort Scott & Memphis, has resigned that position on account of ill health, after a service of 29 years with this road.

Mr. Charles H. Quereau, Master Mechanic of the First Division of the Denver & Rio Grande, has been appointed Assistant Superintendent of Machinery and Acting Master Mechanic of that division, with headquarters at Denver, Col.

Mr. J. T. Stafford has been appointed Acting Division Master Mechanic of the St. Louis, Iron Mountain & Southern, a tributary line of the Missouri Pacific, with headquarters at Baring Cross, Ark., succeeding Mr. Mord Roberts, resigned.

Mr. W. J. Miller has resigned as Master Mechanic of the Southern Division of the Kansas City, Pittsburg & Gulf at Shreveport, La., and Mr. C. A. DeHaven, formerly of the Omaha, Kansas City & Eastern, has been appointed to succeed him.

Mr. George H. Campbell, Terminal Agent at Baltimore of the Baltimore and Ohio Railroad, has been appointed Assistant General Superintendent, with headquarters at Baltimore. Mr. Campbell came to the Baltimore and Ohio Railroad three years ago from the Big Four.

Mr. William A. Patton, Assistant to the President of the Pennsylvania Railroad, and Vice-President of the New York, Philadelphia & Norfolk, has been elected President of the latter road, succeeding Mr. A. J. Cassatt, who has resigned upon election to the Presidency of the Pennsylvania.

Upon the resignation of Mr. W. V. Clark, Superintendent of the Southern Division of the Central Railroad of New Jersey, his associates and the employees of the division tendered him handsome testimonials, the presentation address being made by Mr. William M. Montgomery, Master Mechanic at Lakehurst.

William H. Stearns, one of the veteran motive power officers of New England, Master Mechanic of the Connecticut River Road, died in Springfield, Mass., July 14, at the age of 77. He was Master Mechanic of this road from 1872 until its absorption by the Boston & Maine in 1895. His railroad service began under Wilson Eddy on the Boston & Albany in 1842.

Mr. E. E. Davis, who recently resigned as Assistant Superintendentof Motive Power of the Philadelphia & Reading to accept a similar position on the New York Central, was met by his former subordinates on leaving his office in Reading and presented with a testimonial in the form of a handsome watch as a token of esteem. Mr. Davis responded with words of commendation and appreciation of the efforts of his assistants.

Mr. Samuel F. Prince, Jr., has tendered his resignation as Superintendent of Motive Power of the Long Island, to succeed Mr. L. B. Paxson as Superintendent of Motive Power and Rolling Equipment of the Philadelphia & Reading. Mr. Prince was formerly Mechanical Engineer of the Philadelphia & Reading, and has been with the Long Island for nearly eight years. He is a graduate of the University of Pennsylvania.

Mr. L. B. Paxson, Superintendent of Motive Power and Rolling Equipment of the Philadelphia & Reading, has been appointed Consulting Mechanical Engineer of that road, a position which was made for him in order to relieve him from the arduous duties which he has performed for many years. Mr. Paxson is one of the veteran motive power officers and has been connected with the Reading since 1847, when he began as a freight brakeman. He has been in charge of the motive power department for the past 11 years.

George W. Morris, who for many years represented the interests of the A. French Spring Company, died after a very brief illness at his home in Virginia, July 8. He had not been in active business for some time, and at the recent convention at Old Point Comfort he appeared to be enjoying very good health. Mr. Morris had an unusually wide acquaintance from his long service in the railroad supply business, and there are few men who will be missed as he will. He was a regular attendant at the conventions and had missed but one convention since the two associations were started.

Mr. W. F. Hallstead, Second Vice-President and General Manager of the Delaware, Lackawanna & Western, has resigned after nearly fifty years of railroad service. He was born in Pennsylvania in 1837 and began railroad work as a water boy at the age of 15. He passed through the different grades of train service until he became General Manager, and in 1897 the title of Second Vice-President was given him. He is strong in the grasp of the minor details of operation and knew his subordinates thoroughly. His application to his work is remarkable. He was usually in his office at 6 o'clock in the morning and remained until 5 in the afternoon, with but a brief interval at noon for lunch. He also was accustomed to work from 7 until 9 in the evening at his desk.

New York Central motive power changes are as follows: James Buchanan of West Albany, N. Y., and G. H. Haselton of Depew, N. Y., heretofore Assistant Superintendents of Motive Power, have been appointed Division Superintendents of Motive Power. P. T. Lonergan, heretofore Master Mechanic, has been appointed Division Superintendent of Motive Power on the Rome, Watertown & Ogdensburg Division. The jurisdiction of James Macbeth, Master Car Builder at East Buffalo, N. Y., has been extended over the entire Western Division. The office of Master Car Builder at Rochester, N. Y., has been abolished. The jurisdiction of F. W. Chaffee, Master Car Builder at West Albany, N. Y., has been extended over the Middle Division, and the jurisdiction of S. T. Case has been extended over the Hudson Division. The headquarters of George Thompson, Division Superintendent of Motive Power, has been transferred from Jersey Shore, Pa., to Corning, N. Y.

Mr. John A. F. Aspinall, who has ably filled the position of Chief Mechanical Enugineer of the Lancashire & Yorkshire Railway, England, has been appointed General Manager of that road, and is succeeded by Mr. H. A. Hoy. Mr. Aspinall's appointment is the first instance of the selection of a general manager of an English road from the mechanical department. This is an important and pleasing precedent which is worthy of attention in this country. The mechanical officers have most exacting administrative responsibilities, which appear to fit them admirably for the charge of general management, and the encouragement which a prospect of further advancement would offer could not fail to further improve their administration of their departments. At present there seems to be nothing for the mechanical officials to look forward to in the way of advancement, and yet it is from this part of railroad operation that most is expected in the line of economics.

Mr. John R. Slack has resigned as Mechanical Engineer of the Central Railroad of New Jersey to accept the appointment of Assistant Superintendent of Motive Power of the Delaware & Hudson, with headquarters at Albany. After graduating from Columbia College in 1884, he entered Stevens Institute of Technology and graduated with the degree of M. E. in 1886. He then entered the shops of the New York Central as an ap-

prentice and afterward went to the Frankfort shops of the West Shore as draftsman, under Mr. James M. Boon. In 1890 he became inspector of locomotives for the New York Central and was soon made chief draftsman and later Mechanical Engineer under Mr. William Buchanan. In 1898 he was appointed Mechanical Engineer of the Central Railroad of New Jersey. Mr. Slack was sent abroad by the New York Central in 1896 and made a study of Austrian, French, German and English railroad methods, giving especial attention to the railroads of Austria.

Mr. James M. Barr has tendered his resignation as Vice-President and General Manager of the Norfolk & Western Railway to take charge of the operation of the Atchison, Topeka & Santa Fe Railway System, as Third Vice-President. He began railroad work as a messenger in the office of one of the Superintendents of the Pennsylvania Railroad, and after service in various departments of several roads he was made Superintendent of the Chicago, Burlington & Northern Railway in 1885, since which time he has been employed as Superintendent by the Union Pacific, Chicago, Milwaukee & St. Paul and Great Northern roads, and by the latter road as General Superintendent. He was made Vice-President and General Manager of the Norfolk & Western Railway in February, 1897, and has held this position since. Mr. Barr is a successful operating officer, and while he is a comparatively young man, he has few superiors in the application of business principles to the management of transportation. His success is chiefly due to an exact knowledge of the present costs, from which to base future improvements, combined with a system of management whereby his subordinates are kept constantly informed as to the results of their work. While this is the basis of administration of successful business enterprises in other fields, it is not often seen in railroad work. Mr. Barr has now reached a high place as a railroad officer, but he will go still higher as a result of his clear-headedness, his tireless energy and exclusive devotion to his profession.

THE INTERNATIONAL RAILWAY CONGRESS.

The sixth session of the International Railway Congress will probably open on or about Saturday, September 15, 1900, although the exact date has not yet been fixed. It will be held in the "Palace of Congresses" of the Exposition, Paris.

There have been admitted to temporary membership in the International Commission of the Congress twenty-three French railway officials having special reference to the arrangements for the sixth session. Mr. Paul Brame is Secretary to the Local Committee.

The American members of the International Commission are Chas. P. Clark, New York, New Haven & Hartford; Chauncey M. Depew, New York Central & Hudson River; Theo. N. Ely, Pennsylvania; and Frank Thomson, Pennsylvania.

The American "Reporters" on the questions to be discussed are as follows:

Nature of the Metals for Rails.—P. H. Dudley, Inspecting Engineer, New York Central & Hudson River.

Locomotives for Trains Run at Very High Speed.—Axel S. Vogt, Mechanical Engineer, Pennsylvania.

Use of Steel and Ingot Iron in the Construction of Locomotives and Rolling Stock.—Chas. B. Dudley, Chemist, Pennsylvania.

Brakes and Couplings of Carriages and Wagons.—Geo. W. West, Superintendent Motive Power, New York, Ontario & Western.

Economical Size of Goods Trucks or Capacity of Freight Cars.—L. F. Loree, General Manager Pennsylvania Lines West of Pittsburgh.

Electric Traction.—N. H. Heft, Chief of Electrical Department, New York, New Haven & Hartford.

Handling and Conveyance of Broken Loads.—J. H. Olhausen, General Superintendent Central of New Jersey.

Automatic Block System.—E. C. Carter, Principal Assistant Engineer Chicago & Northwestern.

Railway Clearing Houses.—G. R. Blanchard.

Technical Education of Railway Servants, Appointment and Promotion.—Geo. B. Leighton, President Los Angeles Terminal.

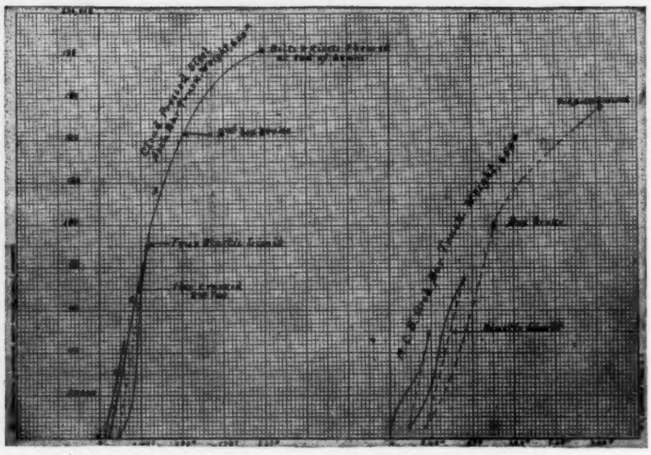
Conveyance of Farm Produce to Stations on the Main Railways.—J. T. Harahan, Second Vice-President Illinois Central.

—[Reprinted from the Official Guide.]

CLOUD PRESSED STEEL ARCH BAR TRUCK.

A new steel truck designed and patented by Mr. John W. Cloud, built and exhibited at the recent conventions by the Cloud Steel Truck Company attracted considerable attention. While the plate side frame has many advocates among railroad men, there are others who prefer the diamond side frame, and the purpose of this design was to supply this form, using a stronger and lighter structure than is to be had with rectangular arch bars.

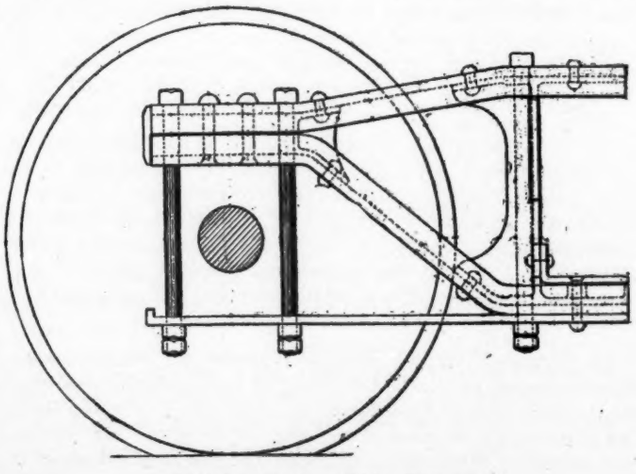
The common form for bending the arch bars has been retained and also the rectangular tire rod. The upper and lower arch bars are made of channels rolled with a section which



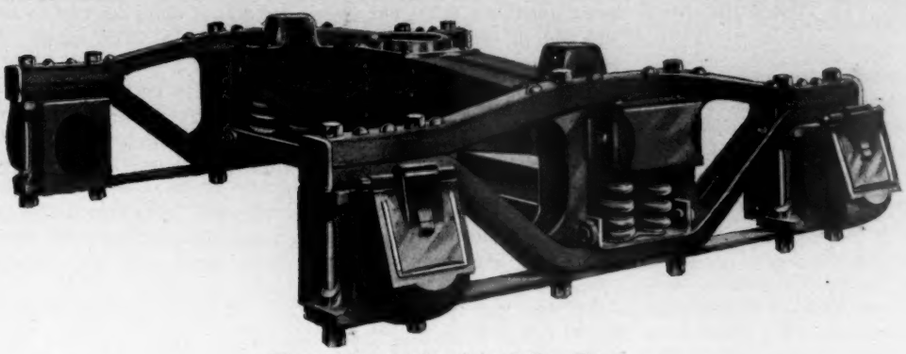
Strain Diagram.

Comparative Test of Cloud Pressed Steel Arched Bar Truck and M. C. B. Arched Bar Truck.

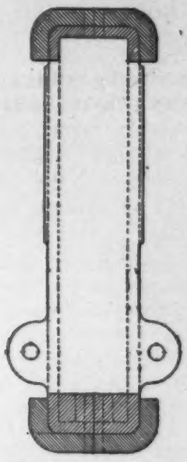
is specially adapted to bending into the desired form. This, it is stated, could not be so well done with any of the present commercial shapes, because of the stiffening effect of the large fillets. The ends of the arch bars are united by means of malleable castings formed to fit the channels. These castings terminate in a flange at the outer ends, forming bearings for the ends of the channels and at the inner ends they give support to the arch bars at and slightly beyond the points of curvature. The column guides are also in the form of a malleable casting, to which the arch bars are riveted. These castings also extend beyond the points of curvature of the arch bars. With this feature and the riveting which is reinforced by the column bolts and journal box bolts, the structure may be expected to give a good account of itself. The column bolts are



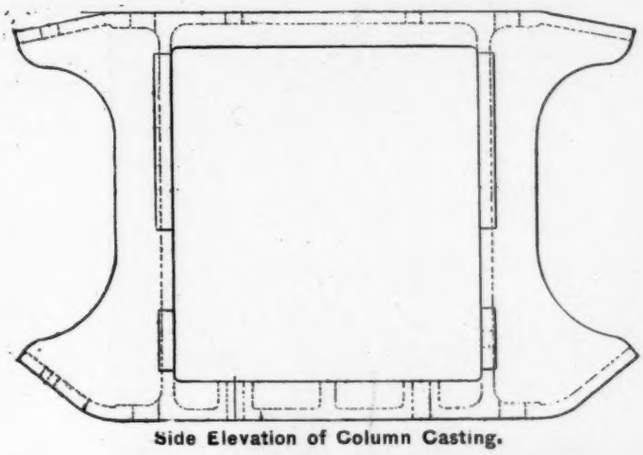
Half Elevation of Side Frame.



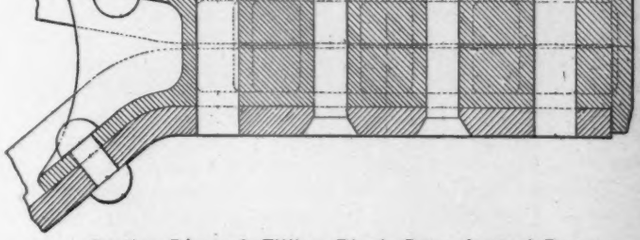
Cloud Pressed Steel Arch Bar Truck.



Section Through Column Casting.



Side Elevation of Column Casting.



Section Through Filling Block Over Journal Box.

1⅛ inches in diameter, the reduction being possible on account of the riveting.

In a recent test at the laboratory of the Armour Institute of Technology, Chicago, one of these diamond frames intended for a car of 80,000 pounds capacity held a load of 90,000 pounds before reaching the elastic limit. An ordinary diamond side frame tested at the same time reached its elastic limit at 45,000 pounds, when it failed by the shearing of the box bolts and the end rivets.

It is easy to see the advantage of the channel over the rectangular form for compression members, and those subjected to bending, but the riveting, the support given to the bends in the arch bars and the reinforcement at the ends are equally important factors in this truck. We are not told the weight of this side frame, but it is probably much less than that of the ordinary diamond frame.

AJAX METAL COMPANY'S NEW BEARING METAL.

Some five years ago the Ajax Metal Company added to its large list of special alloys for railroad and other purposes an alloy which is especially intended for the heavy coaches of fast trains. This alloy was the result of many careful experiments and many observations in the practical usage of compositions intended for similar purposes.

After many trials and many failures a composition was reached which fully met the requirements of such service. So sure were the manufacturers of the merits of their new material before placing it on the market, that they declared their willingness to contract with railroads for brasses made of this composition, guaranteeing to replace free of cost all brasses which should run hot. Several such contracts are now held with the largest users of journal brasses in the country, and we are glad to say that these brasses are supporting the claims which the manufacturers are making for them in a wonderful manner.

We can readily see how such a liberal contract can be entered into when 3,200 scrap brasses, which were recently returned to the foundry, were inspected by the consumers' inspectors, and only 20 brasses required replacement, showing a percentage of hot brasses equal to less than one per cent.

The Ajax Metal Co. is willing to enter into contracts with all consumers of bearing metals on this basis, and is able to quote a price which is by no means the highest which is being paid, but is considerably below this, although in actual value it may be double what roads are paying for inferior material.

This metal is in regular use by a railroad whose service is the hardest in the country, not only in the weight of cars, but also for its long distance runs, its varied roadbed and varied conditions of soil through which the lines pass. This company requires the Ajax Metal Company to replace less than one per cent. of the brasses furnished them.

The excellent service given by this alloy, it is claimed by the manufacturers is due to its homogeneity of structure, and to the plasticity of its particles. Although a hard metal, and well able to withstand the weight of the heaviest coaches, its particles or constituents show great plasticity. Figuratively speaking, the journal made of this material is like a stiff rubber cushion, which supports its load without squashing, but at the same time is plastic enough to adapt itself to the irregularities of the journal, and to prevent the rapid wearing away of its particles.

The great French philosopher, Voltaire, once asked this riddle: "What is the longest and yet the shortest thing in the world; the swiftest and the most slow; the most divisible and the most extended; the least valued and the most regretted; without which nothing can be done; which devours everything, however small, and yet gives life and spirit to everything, however great?"

The American Engineer and Railroad Journal will be sent free for one year to the person from whom the first correct answer is received, by mail at the publication office.

A COURT HOUSE "GOING TO COURT" VIA THE BURLINGTON.

House moving by rail is always interesting, but when a railroad loads up a "county seat" and carries it on a train without laying out regular traffic, the achievement is worthy of record. This is an instance of responsible work done by the local division authorities of the Burlington & Missouri River Railroad, and the following is quoted from a letter to this journal, from an officer of that road, which accompanied photographs from one of which our engraving was made:

"The feat was that of transporting by rail the county seat at Hemingford, Box Butte County, Neb., to Alliance, Box Butte County, Neb., a distance of 19 and a fraction miles. By popular vote the county seat was changed some months ago from Hemingford to Alliance. How it was accomplished hardly needs explanation, as the photographs explain for themselves. The building was placed on four 60,000 pound capacity trucks. You will observe from the pictures that two loaded coal cars are in front and the same number back of the house. These coal cars served the purpose of anchors to which the building was guyed by ropes. Heavy bridge timbers were secured to the lower part of the court house and supported on the trucks. One difficulty that had to be provided for was that of passing trains. To avoid any inconvenience the first part of the journey was made from Hemingford to Berea, the outfit being allowed to remain for the night on the main track, and the through trains east and west ran around it on yard tracks at that point. The following morning, after the trains had all passed, the court house continued its journey to Alliance, reaching there about noon, June 30. In noting the speed it was observed that country wagons, in order to keep up with the speed of the building, had to move along at a trot, the speed being about six miles per hour. Several of the cuts had to be widened in order to let the corners of the building past. It was through loose earth and not much of a job.

"The Hon. J. Sterling Morton happened to be in that vicinity when this transfer was made and dryly remarked that it was the first time he ever saw a court house going to court."

The building weighed about 70 tons and its dimensions were 34 by 48 feet and 45 feet high.

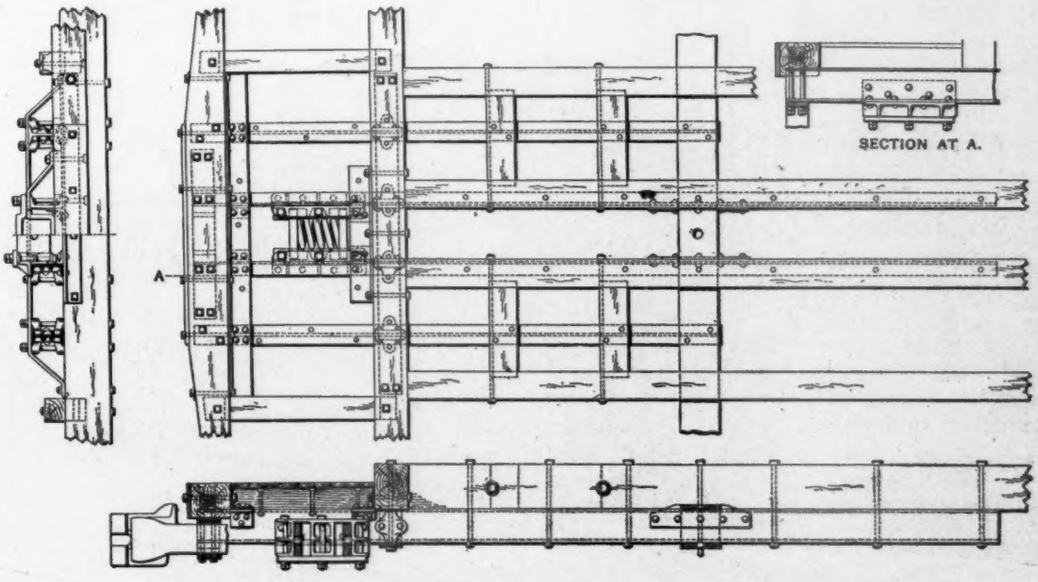
A record of 1,310 tons of steel in a single run has been made at the south mills of the Illinois Steel Co. in Chicago. The men who did this work were those of the regular night shift and were not selected for the occasion.

Moving a Building by Rail.
Burlington & Missouri River R. R.

The presidents and executive officers of the Pennsylvania and its Western connections at a meeting held in New York, June 28, adopted a resolution concerning the late President Frank Thomson, of which the following is a part: "Death has again visited our association and removed from our midst one of its choicest spirits. The name of Frank Thomson has for many years stood for everything that is good. A man of simple and lovable character, he rose to the very zenith of his profession, and, having attained the highest rung of the ladder, he extended to all the climbers below naught but words and deeds of encouragement and cheer. From out of all the wranglings and strife of our modern competitive life no memory remains of this gentle, loving man but that which is sweet and precious to those of us who remain. His death removes from among us a wise counselor and friend, and those of us who were associated with him in life will long cherish his memory as a sacred and loving heritage."

THE STANDARD STEEL CABOOSE PLATFORM.

Mr. H. H. Sessions, Vice-President of the Standard Coupler Company, has designed a new steel caboose platform, which is manufactured by that company. This is a result of the success of the Standard steel platform as applied to passenger cars, the introduction of which has been quite general on many important railroads. Its object is to prevent the sagging of the platforms of cabooses on account of the rough treatment these cars receive. The usual wooden, longitudinal timbers are replaced by steel I beams extending from the platform end sill through the body bolsters. The attachment to the body bolsters and their extension beyond these members relieves the car end sills from a large part of the stresses formerly carried by them. The platform beams are secured at the end sills by bolts passing through the flanges of the I beams and through malleable iron castings riveted to the webs of the beams. No truss rods are used and the form of construction selected gives lateral and vertical strength far superior to that obtained with timber construction. This platform is now in use on the Illinois Central, the Chicago, Rock Island & Pacific, the Oregon Short Line, the Chicago, Peoria & St. Louis, the Minneapolis & St. Louis and the Chicago Great Western.



New Steel Caboose Platform—The Standard Coupler Company, New York.

POSITIVE EXPANSION BOLT.

An expansion bolt for the use of railroads, architects, engineers and others who require a "hidden resistance," has been successfully introduced and is manufactured by Daniel C. Seaman & Co., 1638 Hutchinson Street, Philadelphia, Pa. The bolt is threaded on both ends and the end to be fixed in the wall or similar location carries a circular nut recessed, on its inner face, to receive the outer ends of two wings which are nearly semi-circular in cross section. The wings are held in such a way as to insure the bolt from pulling out. They tighten their hold by spreading when the load is applied, and yet the bolt and fastening may readily be removed from the hole by applying a wrench to the outer end of the bolt. The chief claims made for the device are its tightness, easy application and easy removal. It has been successfully applied to stone and brick work, for smoke stack guys, fastenings for fire escapes, engine bed bolts when secured to solid rock or masonry; also for bridge work, window and door frames and elevator guide tracks in buildings. It is stated that the bolts become firmer as the strain is increased.

ROLLING STOCK STATISTICS.

The advance sheets of the report of the Interstate Commerce Commission, dated July 5, 1899, contain the following information with regard to rolling stock:

On June 30, 1898, there were 36,234 locomotives in the service of the railways. This number is larger by 248 than the previous year. Of the total number of locomotives reported, 9,956 are classed as passenger locomotives, 20,627 as freight locomotives, and 5,234 as switching locomotives, a small number being unclassified. The total number of cars of all classes reported as in the service of railways on the date named was 1,326,174, being an increase of 28,694 as compared with June 30, 1897. Of the total number, 33,595 were assigned to the passenger service and 1,248,826 to the freight service, 43,753 being assigned to the service of the railways themselves. The number of cars owned by private companies and individuals that are used by railways in transportation is not covered by reports filed with the Commission.

An inspection of the summaries which are designed to show the density of equipment and the efficiency of its employment, shows that during the year ending June 30, 1898, the railways in the United States used 20 locomotives and 718 cars per 100 miles of line. Referring to the country at large, it appears that 50,328 passengers were carried, and 1,343,906 passenger-miles were accomplished per passenger locomotive, and 42,614 tons of freight were carried, and 5,530,498 ton-miles accomplished per freight locomotive. All of these items show an increase as compared with those of the previous year ending June 30, 1897.

Including under the term equipment both locomotives and cars, it is noted that the total equipment of railways on June 30, 1898, was 1,362,408. Of this number 641,262 were fitted with train brakes, the increase being 115,976, and 909,574 were fitted with automatic couplers, the increase in this case being 230,849. The summaries indicate that practically all of the locomotives and cars assigned to the passenger service are fitted with train brakes, and that out of a total of 9,956 locomotives assigned to this service 5,105 are fitted with automatic couplers, and 32,697 cars out of a total of 33,595 cars in the same service are also so fitted. A corresponding statement for freight equipment is as follows: Out of a total of 20,627 locomotives assigned to the freight service 19,414 are fitted with train brakes and 6,229 with automatic couplers, but out of a total of 1,248,826 cars assigned to the freight service only 567,409 are fitted with train brakes and 851,533 with automatic couplers. The number of switching locomotives fitted with train brakes was 3,877, and the number fitted with automatic couplers was 1,199. Of the total number of cars of all classes in service on June 30, 1898, 607,786 were fitted with train brakes, the increase during the year being 115,227, and 896,813 were fitted with automatic couplers, the increase in this case being 227,876.

NEW SIX-ROLL DOUBLE CYLINDER PLANING AND MATCHING MACHINE.

J. A. Fay & Co., Cincinnati, Ohio.

This new machine is specially designed for use in car shops and for general planing mill purposes. It has a wide range of work, planing four sides up to 30 inches wide and 8 inches thick, and it will work three sides of two pieces simultaneously, even when they are of uneven thickness, up to 12 inches wide and 8 inches thick.

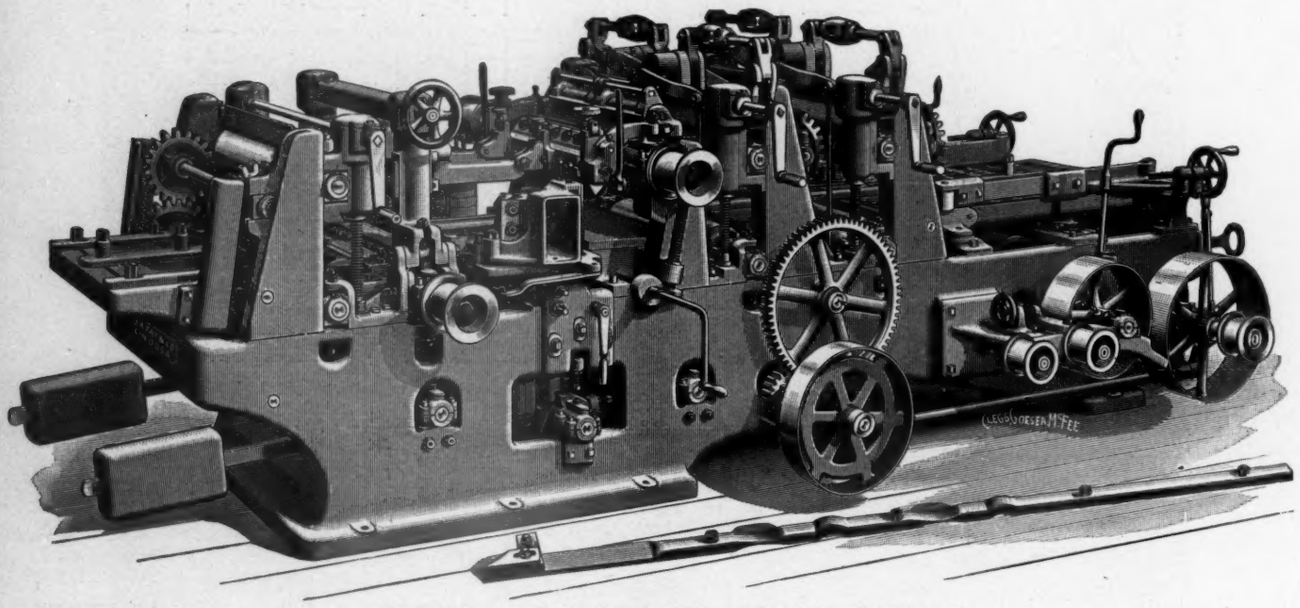
The frame is very massive and that portion supporting the working parts is braced by a long sole-plate or girt. All parts are accurately planed and joined by heavy bolts. A system of interchangeable parts and standard sizes is adhered to throughout by the builders.

The cylinders are two in number, made from solid steel forgings, and have four faces slotted to receive two or four knives, and chip-breaking lips for working cross-grained lumber. The upper cylinder is mounted in a heavy yoked frame, has journal 2¼ inches in diameter, and runs in self-oiling bearings 10½ inches long. The cylinder-raising screws are outside of the frame and are fitted with ball bearings and a device for quickly taking up all lost motion in the screw caused by the wear of the threads. The lower cylinder is mounted in a heavy yoked frame, has 2¼-inch journals that run in self-oiling bearings 10½ inches long, and is vertically adjustable at each end.

The matching works are heavy. The arbors are of steel 1¾ inches in diameter where the cutter-heads are applied, and revolve in long bearings, both of which are adjustable vertically and horizontally, and are rigidly locked in any desired position by a lever conveniently located outside the frame. The top plate of each matcher hanger is detached from the main casting for convenience and economy. The machine will match stock from 2 to 30 inches wide.

The feed works consist of six large feed rolls 8 inches in diameter, driven by a train of powerful gearing, each gear on a shaft extending through the machine and running in babbitted bearings. The expansion gears on the feed rolls are inside the frame, and run in bearings. The screws for raising the rolls do not revolve, the rolls being mounted in sleeve housings that travel on the screws. This makes the roll adjustment very easy, as the pressure weights do not have to be lifted. The upper feed rolls in front of the upper cylinder are divided in the center for the purpose of feeding simultaneously two pieces of material of uneven thickness through the machine. These divided rolls are heavily weighted ,and may be aligned at any time by the new lift, or adjusted out of line with the platen to lead the lumber to the center guide. All roll boxes are long and large in diameter. The feed-out roll is provided with scrapers. The weight levers are inside the frame, and move with perfect freedom. It has three speeds of feed, viz., 30, 45 and 60 feet per minute. The feed is under instant and positive control of the operator by means of a lever engaging a ring friction.

The pressure bar in front of the upper cylinder is divided and adjustable to and from the cut, and has chilled toes, reducing wear to a minimum. The bar behind the cut is adjustable for difference in thickness of material worked. The bars in front of and behind the lower cylinder are adjustable to and from the cut, and are vertically adjustable for varying depths of cut. The bar over the lower cylinder is adjustable on heavy stands, and is securely locked in position. It can be swung over from either side by simply loosening one nut. Continuous pressure bars extend over the matching works with independent adjustment, and they may be quickly thrown out of the way to give access to the heads.



Six-Roll Double Cylinder Planing and Matching Machine.
J. A. Fay & Co.

This machine is equipped with a new and improved belt-tightening apparatus for both cylinder and side-head belts, quickly adjustable while the machine is running, and permitting the use of endless belts, that run more smoothly and do not require to be cut for the stretch to be taken up. By the use of this apparatus 2-inch stock may be matched, and the belts stand at least 10 inches apart on the countershaft.

The address of Messrs. J. A. Fay & Co. is 516 to 536 West Front Street, Cincinnati, Ohio.

THE GILMAN-BROWN EMERGENCY KNUCKLE.

This device is intended for use in cases of failure of the knuckles or locking devices of M. C. B. couplers. It is a steel casting weighing 52 pounds, and the long tail of the knuckle passes into the cavity of the draw bar, to prevent rotation,

while the pivot pin takes the stress from pulling and buffing. The shape of the emergency knuckle is such that it will fit about 90 per cent. of the 80 or more kinds of M. C. B. couplers that are now in service, and it is intended to be carried in cabooses in order to replace broken parts and to avoid the pres-

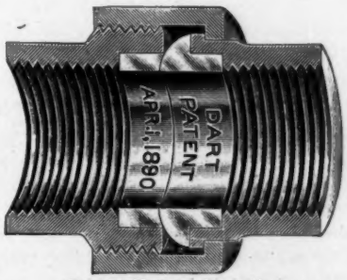
The Qilman-Brown Emergency Knuckle.

ent difficulty of carrying a large number of different makes of knuckles for running repairs. This knuckle is rigid and is for use in taking the train to a repair point, where the right knuckle for permanent repairs may be obtained. It appears to have an important field.

It is manufactured and sold by the Railway Appliances Co., 680 Old Colony Building, Chicago, of which Mr. Geo. H. Sargent is Manager.

DART'S UNION COUPLING.

The union coupling patented and manufactured by E. M. Dart Manufacturing Company, Providence, R. I., is brought to our attention because of the good results given in the extremely severe service of steam and other piping about locomotives and cars. The casing of the union is fitted to receive seats of bronze which form a ball joint with which pipes may be connected and made tight, even when considerably out of line, and the metal used prevents corrosion, which insures durability. The joints of locomotive and car piping are subjected to a con-



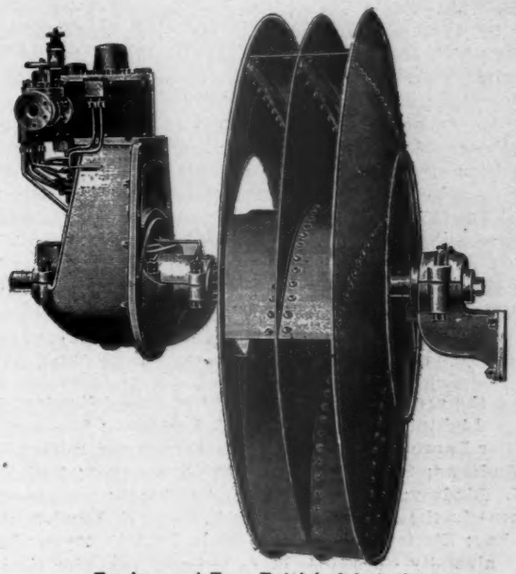
Dart's Union Coupling.

stant jar and vibration which tends to loosen ordinary unions and cause them to leak, but the reports from uses of this form indicate that it is very successful. They have now been in use for four years and we are informed that the Brooks Locomotive Works recently placed an order for 5,500 of them, in sizes varying from ¼ inch to 2 inches. They are also used by shipbuilders, smelters and miners, and a number have been sent out to the Chinese Eastern Railway, the device being adaptable wherever union couplings are used. Further information may be had from the manufacturers.

Locomotives on the Boston & Maine hauling passenger trains between Boston and Rockport, Mass., are using coke for fuel experimentally.

ENGINES AND FANS FOR THE BRITISH ADMIRALTY.

The accompanying illustration, taken from "The Engineer," shows one of the latest types of forced-draught steam fans, made for the British Admiralty by Messrs. Gwynne & Co., of London. The fans, which are open, of the double-breasted type, are built of steel, and are designed to combine the greatest strength with lowest possible weight. The engines, which are very compact, are of strong construction, being suitable for running when desired with a steam pressure of 300 lbs. per square inch, and also capable of performing full duty at 200 lbs. pressure. Their normal speed is 500 revolutions per min-



Engine and Fan, British Admiralty.

ute. The crank shafts are of best steel, cut out of the solid, the connecting-rods and eccentric-rods of the nighest grade of manganese bronze, and all the bearings and working surfaces are of exceptionally large proportions, to minimize wear under the trying tests of high speeds and pressures to which these engines are subjected in work. The ends of the fan spindles opposite to the engines are carried in bearings of special construction, having a universal adjustable provision to prevent strain of the spindles should the true alignment be disturbed from any cause. Every precaution has been taken to insure continuous lubrication of all the moving parts while the engines are running.

BOOKS AND PAMPHLETS.

Steam Boiler Practice in Its Relation to Fuels and Their Combustion. By Walter B. Snow. 297 pages; illustrated. New York: John Wiley & Sons, 1899. Price $3.

This book will be in demand among engineers, users of steam boilers and students. It has a field of its own, which is high praise for a book on boilers in these days. Its mission is to show the results of different methods of using boilers, rather than to treat the causes, and the appliances used. The work throughout testifies to the wide range of the author's investigation and research, and this is specially evident in the portions devoted to fuel and combustion. The author presents his subjects in a simple and clear style and refers the reader to a large number of authorities for more exhaustive investigation. The effect of the book is to stimulate study on the part of the reader, whether he is responsible for the working of steam plants or not, and it is made perfectly evident that careful attention to methods of operation are quite as important in steam boiler practice as the employment of expert advisors in the planning and construction. It is equally clear that the installation expense of a plant may be increased slightly with great advantage in the direction of draft appliances.

The book is divided into chapters, as follows: Steam Boiler

Practice; Water and Steam; Combustion; Fuels; Efficiency of Fuels; Efficiency of Steam Boilers; Rate of Combustion; Draft; Chimney Draft and Mechanical Draft.

The work abounds in valuable and carefully selected tables, and the author presents his own conclusions, drawn from the experience and published records of the best experimenters. The author has made a special study of draft and its effects upon combustion, and the book leads up to and includes an admirable presentation of the advantages of mechanical over chimney draft, Mr. Snow being a recognized authority on this subject. The study of the use of fuel, as covered by this book, is exceedingly important for every engineer and user of steam power, especially in view of the possibilities of making use of the cheaper grades of coal. Mr. Snow shows how to save a great deal of money by moderate expenditures for plant and the use of methods which are necessary for the burning of difficult fuels. One cannot read the book without becoming impressed with the importance of the subject, which is not generally appreciated. In connection with mechanical draft, a good discussion of the theory of fans is given, much of this part of the book having been prepared by the author last year and published in book form by the B. F. Sturtevant Co., under the title, "Mechanical Draft."

The present work should be consulted in connection with the design of new steam plants, and also in rearranging and enlarging old ones. The mechanical officers of railroads will find it particularly profitable.

University of Georgia. The Engineering Society Annual 1899 Volume IV. Chas. Morton Strahan, Editor in Chief, Athens, Ga.

Among the articles in this pamphlet are the following: Some Points on Lightning Protection, A. H. Patterson; Street Cleaning in Our Large Cities, J. H. McIntosh; On the Rotary Field, C. R. Andrews; Sewage Disposal, E. P. Shannon; Tall Buildings, K. Lindsey; Liquid Air, J. M. Brockman; Suggested Improvement in the Athens Filtering System, E. Lyndon and C. M. Strahan; Electricity on War Vessels, D. J. D. Myers; Drawin the University Curricula, E. L. Griggs; The Electrical Department and Its New Equipment, U. H. Davenport; Tests of Vitrified Brick, J. W. Barnett, C. E.

The Standard Steel Works, Harrison Building, Philadelphia, Pa., have issued a catalogue of steel tires and steel tired wheels, a copy of which we are glad to receive. It contains engravings of the works, the machinery employed and the processes of wheel and tire making. In addition to these features the book contains chemical and physical requirements of tires for American, English, Russian, Japanese and Finland railroads. The tires furnished without special specifications are made to the following proportions, which are considered after service experience to be adaptable to railroads in all parts of the world: Carbon, 0.65 to 0.75 per cent.; phosphorus, below 0.05; silicon, below 0.25; manganese, 0.50, 0.70; sulphur, below 0.05; tensile strength, 110,000 to 125,000 lbs.; elastic limit, 55,000 to 65,000 lbs., and elongation in two inches 15 to 25 per cent. This company manufactures tires for driving wheels and car wheels, steel tired wheels with forged wrought-iron centers, also with cast-iron and forged cast-steel centers; steel castings for locomotives, including locomotive frames, and steel or iron forgings for railroad purposes. The annual capacity for locomotive tires is 20,000, and for wheels 15,000. An impressive story is told in half-tone engravings showing the large amount of material scrapped from the top ends of ingots and the effect of this practice on the finished product is exhibited in prints from etched sections of driving wheel tires, showing the porous condition of a tire in which some of the spongy top of an ingot was used instead of being returned to the furnace for remelting. The practice of these works is to cast long ingots, which are cut in four pieces, the top one being discarded. The catalogue also includes illustrations of tire fastenings and information which should accompany orders for wheels.

The Bullock Electric Manufacturing Co., Cincinnati, O., General Catalogue No. 24.--By aid of excellent half-tone engravings this catalogue describes the electrical equipment manufactured by this firm. After detailed descriptions of the generators and motors, a number of direct connected generating sets are illustrated, after which the application of electric motors to printing presses and to the direct driving of machine tools are shown. This company has been in business for 10 years, being formerly known as the Card Electric Motor & Dynamo Company. An excellent and instructive example of electric driving is seen at their works in Cincinnati, as illustrated on page 225 of our July issue. In general design the Bullock machines are graceful in appearance, compact and strong. Circular field frames are used and the laminated pole pieces are cast into them. The field coils are machine formed, the shunt and series coils being wound separately and made independent of each other to permit of proper ventilation. The testing at the factory includes successful running of every motor for a considerable period. The brush holders are of the radial reaction, carbon type, one of the features of the operation being noiseless and sparkless running. The armatures are built up of thin charcoal-iron discs with radial air ducts at intervals throughout the body, through which the air is forced by the rotation of the armature. Maple wedges, placed in recesses, protect the armature coils from external injury. The commutators are built up of drop forged Lake Superior copper. The motors are in general identical with the generators except that the fields are shunt wound instead of compound. They are said to be sparkless under any change of load within their capacity. Motors of Type E are shunt or series wound of the multipolar design and are made specially for direct connection to machine tools, printing presses and other machinery. They may be placed on the floor, bolted to the ceiling, or secured direct to the base plates of machines to be driven. Slow speed motors of this type, when attached direct to a machine tool, permit of doing away with belts and make it possible to save the constant friction load of long lines of shafting. These motors may be directly connected to the line shafts, as in the case of the shops of the Mergenthaler Lynotype Co., Brooklyn, where they are run at 180 revolutions per minute, the subdivision being into motors of 10 horse power. The operating devices are simple. They give a "slow motion" and 21 speed adjustments. For machine tool driving Type E multipolar slow speed motors, running at 360 revolutions per minute, are used. One of these is shown in the catalogue, driving a 72-inch planer. Other illustrations show a motor driven lathe in operation at the plant of Joseph Adamson & Co., Hyde, England. In other illustrations motors are connected directly, without belts, to a shaper, a punch, a railroad shop wheel press using hydraulic pressure up to 100,000 pounds per square inch, and to an upright drill press.

The Janney Coupler.—The McConway & Torley Co., manufacturers of the Janney coupler have issued one of the finest and most satisfactory catalogues that we have ever received. It contains illustrations and lists of parts of the various forms of Janney equipments for passenger cars, freight cars and locomotives, not only the most recently improved developments in the automatic appliances of these manufacturers, but also the earlier combinations, and is therefore a guide for ordering repair parts of equipments which have been in service for a number of years, as well as those having the most recent improvements. The text and tabular matter is all given on the left hand pages of the book and each right hand page is a plate containing the engravings shown in great detail. The engravings throughout are wood cuts of the clearest description, and those of the combinations, such as the passenger and freight equipment assembled in position, are remarkable examples of clear engraving, the like of which is very seldom seen anywhere. The specialties of the McConway & Torley Company are all shown, including the Buhoup improvements, and it is unnecessary to mention them in detail. Every individual part of the equipment is numbered in the catalogue and these are all grouped in an index of details. The book concludes with a general index giving the index number of all the parts and the page number in the catalogue on which they may be found. The book is standard size, 9 by 12, bound in boards and is printed on wood-cut paper.

Brazing by Immersion.—The Joseph Dixon Crucible Co. have issued a pamphlet with the above title, reprinted from "The Cycle Age." It is the most complete article on modern methods of brazing and the apparatus used that has come to our attention. It describes the brazing crucible manufactured by the Joseph Dixon Crucible Co., for liquid brazing, which was illustrated in the "American Engineer," January, 1898, page 25.

The Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., has added five numbers to its series of catalogues in pamphlet form. The subjects are: Transformer fuse blocks, Shallenberger integrating watt-meters, No. 38-B railway motors, generators and rotary converters for electrolytic work, and belt driven railway generators. The pamphlets are admirably gotten up. The descriptions are brief and to the point and the engravings show the views of the apparatus, which purchasers will want to see. They also contain dimensioned drawings and directions for ordering. These pamphlets are numbered and dated. The separate pamphlet plan is well adapated to the purpose of keeping information up to date in a line of work that is undergoing constant change and improvement.

A TESTIMONIAL TO MR. JOHN W. CLOUD.

The friendly feeling of the Master Car Builders' and the Master Mechanics' Associations to the retiring secretary, Mr. John W. Cloud, found expression at the recent conventions in complimentary resolutions passed by both organizations. These resolutions have been supplemented by a handsome testimonial in the form of a Jurgesen watch, valued at $400, bearing the following engraved inscription: "Presented to John W. Cloud by his friends of the Master Car Builders' Association and the American Railway Master Mechanics' Association, June 21, 1899." The idea was suggested by Mr. C. A. Schroyer, President of the Master Car Builders' Association, and Mr. J. H. McConnell, President of the Master Mechanics' Association. Mr. Cloud responded in a letter expressing his thorough appreciation of the feeling toward him which prompted such a generous and cordial remembrance.

EQUIPMENT AND MANUFACTURING NOTES.

Orders for seven Baldwin-Westinghouse electric locomotives have been placed by the Imperial Government Railways of Japan for use in the Government and other mines in Japan.

The Atlantic Brass Co. of New York has opened an office in Room 1200, Fisher Building, Chicago, in charge of Mr. A. R. Perry as Western agent.

Laughlin & Company have ordered twenty-five 100,000-lb. capacity steel hopper cars of the Pressed Steel Car Co. The cars will be of practically the same type as the new cars for the Lake Shore.

Chicago Rabbeted Grain Doors will be used on 500 box cars for the Illinois Central, the contract for building having been made with the American Car & Foundry Company, St. Louis, Mo.

The Pressed Steel Car Company is reported to have closed a contract with the Carnegie Steel Co., Ltd., for $6,000,000 worth of steel plates per year for ten years. It is said to be one of the largest contracts ever made in this country.

The Pennsylvania has just completed three Class PK passenger coaches at the Altoona shops. They have the Linstrom brake arrangement, automatic window hoists, Wheeler & Wilson seats and are to be used in fast train service.

The Chicago & Northwestern Railway has ordered 32 freight locomotives of the ten-wheel type, known as Class R, with 20 by 26 inch cylinders, from the Schenectady Locomotive Works. There are about 40 engines of this class now in service on this road.

The Modoc Soap Company, manufacturers of the Modoc Liquid Car Cleaner and Modoc Powdered Soap, are rapidly extending their trade and during the past few weeks have received orders from Africa, China, England and Nova Scotia in addition to the orders from railroads in the United States.

Since July 4 the Pressed Steel Car Company has delivered 168 cars to the Pittsburgh & Lake Erie Railroad, 40 to the Lake Terminal Railroad, operated by the Lorain Steel Company, and 119 on a large order received from the Oregon Short Line.

Fast Mail train No. 8 on the Chicago, Burlington & Quincy Railroad left Mendota, Ill., on June 28, forty minutes late, and ran to Riverside, a distance of 72 miles, in 62 minutes, or at the rate of 69.67 miles per hour. The train was hauled by one of the class "P" Baldwin locomotives, No. 1,591, which was illustrated in our issue of May, 1899, page 141.

The Baldwin Locomotive Works have received orders for 13 consolidation locomotives from the State Railways of Finland for delivery before the close of this year. Forty locomotives have been shipped to the Chinese Eastern, and before the end of the year 31 more are to built. The second installment of 10 engines for the Midland Railway of England has been shipped and we are informed that 10 locomotives for the State Railway of France are to leave for Bordeaux within a few days.

The Philadelphia & Reading have prepared plans for new shops at Reading. It is stated that the improvements will cost $500,000, although the details of the undertaking have not yet been concluded. Despatches from Reading state that the main building of the new plant will be 300 by 700 feet. It is probable that the present shops will be leased to a manufacturing concern.

The Peerless Rubber Manufacturing Co., 16 Warren St., New York, have issued a folder in colors designed to attract attention to the merits of rainbow packing and other specialties of their manufacture for use in steam pipe, hydraulic and ammonia apparatus joints. The folder contains a caution against substitutes of rainbow packing fraudulently offered by some dealers, and offers a reward for information concerning such transactions. Mr. C. H. Dale, president of the company, evidently intends to protect patrons against imposition.

The business done by the Chicago Pneumatic Tool Company during the month of June has been the largest in its history, over five hundred orders for pneumatic tools of various kinds being booked. Their shipments included a large number of tools for Europe, one large order to the South African Republic and one to Australia. The factory of the National Pneumatic Tool Company of Philadelphia, the control of which has recently been acquired by this company, is running to its fullest capacity both day and night, as is also the case with the St. Louis factory, it being necessary to do this to keep pace with the orders.

The New York Blower Company, of which Mr. DeWitt T. Lyons is General Manager and Mr. Walter G. Holmes General Superintendent, have offices at 39-41 Cortlandt St., New York. The Boston Blower Company recently changed hands and these gentlemen, formerly connected with that firm, have associated themselves with the New York concern, whose works are in Louisville, Ohio. New machinery and skilled men have been assembled there under the supervision of Mr. Holmes, who was formerly superintendent of the Boston concern. The president of the New York Blower Company is Mr. R. C. Penfield. Information and prices for blowers, exhausters, heaters and engines may be obtained from the New York office.

The Electric Axle Light & Power Co. was incorporated at Trenton, N. J., on July 8, with an authorized capital of $25,000,000, for the purpose of "lighting, heating, ventilating and refrigerating" railroad cars by means of electric currents generated from the revolutions of the car axle. The company has absorbed the National Electric Car Lighting Co. of New York, Mr. Max E. Schmidt, President, which controls the Moskowitz axle light in use on 100 cars on the Atchison and on a number of cars on other roads. The National Company was incorporated in 1894 and has had outstanding $2,000,000 of common stock and in January last proposed to issue $500,000 preferred. The new enterprise is backed by Isaac L. Rice and others identified with the Electric Storage Battery Co. The entire stock is to be paid for, and will be issued without bonus or commission of any kind.

The Curtain Supply Company has purchased the entire business, patents and machinery of the curtain and curtain fixture departments of the Adams & Westlake Company, of Chicago; the E. T. Burrowes Company, of Portland, Maine; and Forsyth Brothers Company, of Chicago, and the curtain and curtain fixture situation is now entirely cleared of the annoyance due to patent litigation. The plant of the new company is well equipped with modern machinery, and prompt filling of orders is promised. The factory and general offices occupy a large area at 85 to 93 Ohio Street, Chicago, and the disposition of the business appears to be a very satisfactory one. Mr. A. L. Whipple is the traveling representative of the company, and his wide acquaintance and his dignified, business like methods will be very valuable to the concern. The officers are Mr. E. T. Burrowes, President; Mr. W. W. Willits, Vice-President, and Mr. W. H. Forsyth, Secretary and General Manager.

The Bullock Electric Manufacturing Co. have a growing list of patrons, which is gratifying from a business point of view, and it is also an indication of the appreciation of the advantages of electric distribution of power in manufacturing and printing establishments. During the month of June just passed orders were received for 27 generators with an aggregate of 950 kilowatts capacity and 79 motors aggregating 1,050 horse power, many of the orders being for extensions of existing equipments, while others are for new outfits complete. Electric distribution is now indispensable in a large printing establishment and there are five prominent publishing concerns in this list, such as the "Hartford Times" of Hartford, Conn.; The Butterick Publishing Co., New York; R. Hoe & Co., New York; "The Nottingham Guardian," Nottingham, England; The Lawrence Publishing Co., Cleveland, Ohio., and the "Birmingham Daily Post," Birmingham, England. All of these orders were for complete printing press equipments. Among the other orders, several were from electric railways, one from the United States Government for the Mint at New Orleans, one from the Forbes Lithograph Co., Chelsea, Mass., and E. R. Durkee & Co., of New York. The last mentioned firm already has 26 Bullock motors in operation. The exhibit gives the best of evidence that manufacturers and others are awakening to the necessity for improved methods of shop operation. In selecting the Bullock machinery they have the advantage of dealing with a concern which has a reputation for reliability and skill. This company is far advanced in the application of motors direct connected to machine tools. Their catalogue No. 24 is worth sending for.

The Union Boiler Tube Cleaner Company of 253 Penn Ave., Pittsburgh, Pa., was organized in 1895 for the purpose of introducing an entirely new industry, that of removing scale from the interiors of the tubes of water tube boilers. It is to-day the only concern of the kind in the world having machinery especially designed for their specific business, patented abroad as well as in this country, by which they are enabled to contract for thoroughly cleaning boilers under a time limit with bond for heavy penalty for non-fulfillment or to sell or lease tools for cleaning all makes of water tube boilers having straight horizontally inclined or vertical tubes and those having curved tubes, such as the Climax and Stirling boilers; also the Hazelton, having closed end tubes; the latter three types being heretofore considered, and without these devices are yet, impossible to clean. They commenced business as a firm May 1, 1895, a time of the greatest depression in industries in the history of the country, notwithstanding which the great merits of their devices caused their immediate adoption by some of the largest concerns in the United States and England. Their value as a fuel saving device as well as one that increases the efficiency of boilers even when practically new, if not entirely so, was such as to call forth high praise from users and such is the continued demand that notwithstanding the fact that the manufacturers started with a well equipped factory, they are constantly enlarging their works, putting in additional machinery, and have more than doubled their force of workmen since the first of the year in endeavoring to keep up with orders. The device makes use of a flexible shaft which is unique in its way, having been compelled to design one to enable them to clean boilers having curved or other tubes inaccessible for a stiff rod, owing to the fact that other shafts would not stand the wear and tear under great stress.

In the last week in June, 1899, the Pressed Steel Car Company delivered 205 100,000-lb. capacity steel hopper cars to the Pittsburgh & Lake Erie Railroad Company, and 17 on an order for 1,000, to the Lake Shore & Michigan Southern. In addition 100 carloads of trucks, bolsters, center-plates, etc., were shipped to various railroad companies. The total valuation of shipments for the week exceeded $368,000. The sales for the month of June, 1899, aggregated $1,250,000. Exclusive of the steel cars, the total weight of the manufactured material delivered, June 24th to 30th, inclusive, was 4,397,405 lbs. Since December 13th, last year, 12,598 steel cars have been ordered of the Pressed Steel Car Company for delivery this year, of which nearly one-half has been delivered. The Pennsylvania Railroad, B. & O., B. & O. S. W., Lehigh Valley, Philadelphia & Reading, P. B. & L. E., Oregon Short Line, Union Pacific, L. S. & N. S., P. & L. E., L. S. & I., Great Northern and Egyptian State Railways are roads which have ordered heavily. Cars were ordered the first six months of the year at the rate of $25,000,000 per year.

MASTER CAR BUILDERS' ASSOCIATION REPORTS.—CONCLUDED.

Brake Shoe Tests.

Committee—S. P. Bush, R. P. C. Sanderson, Geo. Gibbs.

At the last convention of the Association it will be remembered that this committee reported that arrangements had been made for the transfer of the brake shoe testing apparatus to Purdue University, where it was to be properly cared for by the University and protected from loss by insurance, under a written agreement presented for file with the Secretary of the Association. Your committee this year would state that the transfer of the testing apparatus had been effected, and that it is now in operation at Purdue University. Purdue University is using it for instructive purposes, and they will also be glad to make tests for any manufacturers that may wish to have tests made, upon the payment of a nominal fee which will cover the expense that the University may be put to.

Since the original tests made by the committee there has been considerable activity in the way of developing brake shoes to produce greater efficiency, with the view particularly of obtaining greater durability of brake shoes in service. This effort has been in the direction of composite, or composition shoes, and while greater durability is very much desired, it is also important to the railways in general that durability should not be obtained at the sacrifice of proper braking power. There are perhaps three or four shoes being produced to-day which it might be well for the Association to have tested under the direction of its committee, with the view of determining their frictional values, comparing them with the original tests of hard and soft cast iron, and your committee would recommend that it be instructed to test such brake shoes as may be presented to it for that purpose and which may seem to have made sufficient departure from those previously tested to have effected their efficiency or durability.

MASTER MECHANICS' ASSOCIATION REPORTS.—CONCLUDED.

Flanged Tires.

Committee.—S. Higgins, W. Garstang, W. H. Thomas.

The desirability of using flanged tires on all the driving wheels of mogul, ten-wheel and consolidation engines depends on certain conditions which have to be taken into consideration, and these conditions are as follows: 1. Length of rigid wheel base; 2. Length of total wheel base; 3. Are rigid or swing-motion engine trucks used?; 4. Lateral motion between driving box and hub when engine leaves shop?; 5 Lateral motion between engine truck box and hub, when engines leave shop; 6. Degree of curvature on line where engines are to be operated; 7. Practice of roadway department as to the gauge used on curves.

A summary of the information (from roads owning a total of 12,265 locomotives) received in reply to the circular is as follows:

	All Flanged.	1 and 3 Flanged.	2 and 3 Flanged.	1 and 4 Flanged.	1, 3 and 4 Flanged.	Total.
Mogul	440	743	....	....	....	1,183
Ten-wheel	534	1,048	702	....	....	2,284
Consolidation ..	348	....	....	1,313	405	2,066
Total	1,322	1,791	702	1,313	405	5,533

	Longest rigid wheel base— All Flanged.	Longest rigid wheel base— Partly Flanged.	Longest total wheel base— All Flanged.	Longest total wheel base— Partly Flanged.
Mogul.....	16 ft. 1½ in.	16 ft.	23 ft.	23 ft. 10½ in.
Ten-wheel....	14 ft. 4 in.	16 ft.	24 ft. 10 in.	26 ft. 6 in.
Consolidation.	16 ft. 3 in.	16 ft. 3 in.	24 ft. 2 in.	24 ft. 6 in.

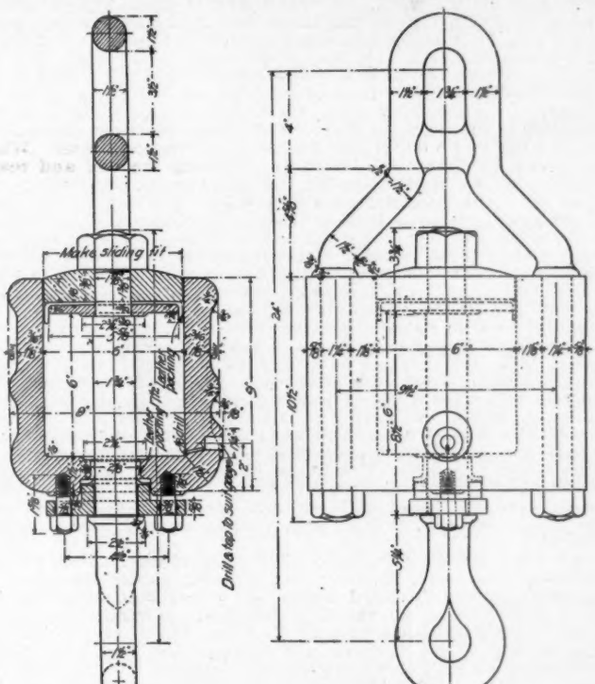
A swing motion engine truck is used with the three types of engines having all tires flanged, the motion being 1½ inches each side of center. The same practice prevails with mogul, consolidation and many ten-wheel engines having tires

partly flanged, but about 50 per cent. of the ten-wheel engines with tires partly flanged have rigid trucks. No matter whether engines of the types referred to have flanged tires on all driving wheels or not, the prevailing practice when such engines leave the shop is to have the lateral motion in each driving box ⅛-inch, and the same with each engine truck box. With tires partly flanged, the distance between backs of flanges for each type of engine covered by this report appears to be 4 feet 5¼ inches.

In the case of engines having flanged tires on all driving wheels, the same practice prevails for mogul and ten-wheel engines. The prevailing practice with consolidation engines having flanged tires on all driving wheels is to have the distance between flanges on first and fourth pair of wheels 4 feet 5⅛ inches, and on the second and third pair of driving wheels 4 feet 5¼ inches.

The sharpest curvature reported from roads using all-flanged tires is 18 degrees. The sharpest curvature reported from roads that use engines with driving wheels partly flanged is 16 degrees.

On a majority of roads that have replied to the circular, the track is laid wide of gauge on curves, but there does not appear to be an exact ratio between the degree of curvature and the amount that the gauge is widened.



Dynamometer Used in Tests.

The roads using flanged tires on all driving wheels, also the roads using flanged tires on a part of the driving wheels, report that their practice has not caused any trouble, and the benefits resulting from each practice are claimed to be as follows:

1. With flanged tires on all driving wheels: Less flange wear, as the pressure between the flange and the rail is distributed more; more uniform wear of flanges and driving wheel hubs; as the tires wear down, the flange gives them greater strength, and there is less liability of thin tires slipping on center; it is necessary to carry but one kind of tire and brake shoe in stock; engines ride better on curves and there are less derailments.

2. With flanged tires on a part of the driving wheels, it is claimed that there is less flange wear, engines curve easier, less liability of climbing the rail, less wear of rail heads; less trouble with sharp flanges.

It will be seen from the above that the advantages claimed from each point of view are about the same, with the exception that the roads using flanged tires on all driving wheels have the advantage as to the variety of tire and brake shoes to be carried in stock, and as to the strength of the tire when reduced in thickness by wear.

In order to obtain information as to the resistance offered by a locomotive when passing through a sharp curve, the committee decided upon making some tests with a consolidation locomotive, assuming that that type of engine would represent the worst conditions. The tests were made on the tracks of the Lehigh Valley Railroad near Coxton, Pennsylvania, on a curve of 15 degrees and 10 minutes with a grade of 56 feet per mile.

The engine with which the tests were made was of the consolidation type. The spacing of the wheels, weight on each pair of wheels, etc., are shown on drawing below:

The engine was just out of the shop. Lateral motion in each driving box ⅛-inch. Lateral motion in each truck box ⅛ inch. Swing motion engine truck; motion either side of center 1½ inch. Main rods and valve rods disconnected. Boiler full of water. The tests were made by hauling engine 688 through the curve at Coxton, entering the curve at the lower end, so as to have the grade to contend with, viz: 56 feet per mile.

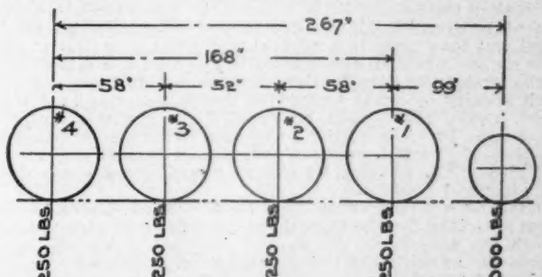
The coupling between engine 688 and the engine that was used for moving engine 688 was made by means of a dynamometer furnished by Mr. Garstang, Superintendent Motive Power of the Big Four Railroad, and a drawing of the dynamometer will be found at the end of the report.

Three series of tests were made, the first test being made with flanged tires on first and fourth pair of wheels, plain tires on second and third pair of wheels. The second test was made with flanged tires on first, third and fourth pair of wheels, plain tires on second pair of wheels. The third test was made with flanged tires on all driving wheels. The tires used were new, Master Mechanics' Standard Section; width of flanged tires, 5¾ inches; width of plain tires, 6½ inches. In tests 1 and 2 the flanged tires were located so that the distance between backs of flanges was 53¼ inches, while the distance between the inside of plain tires was 52½ inches. In the third test the distance between flanged tires on first and fourth pair of wheels was 4 feet 5⅛ inches; on the second and third pair of wheels 4 feet 5¼ inches.

The plain tires were located on driving wheel centers, so that the center of the tread of the tire coincided with the center of the rail head on straight track.

In connecting the dynamometer between the two engines no springs were used, as the draw castings on each engine were bolted solid.

Several trips were made with each arrangement of flanged



Wheel Base of Engine No. 688.

tires and plain tires, and readings were taken on each trip, while the engine was being pulled through the curve. A uniform speed of twenty-eight miles per hour was maintained during each trip, except the last trip of each test, when the speed was reduced to five miles per hour. (A summary of the readings taken on the different trips is given in the report.)

It will be noted from the readings that the power required to pull the engine through the curve with the different arrangement of tires is practically the same. The members of the committee are not prepared at this time to make any recommendation as to the desirability of using flanged tires on all driving wheels of mogul, ten-wheel and consolidation engines, but have presented all the information on the subject that they have been able to gather, and the committee now suggests the advisability of the investigation being continued, so that a final report can be made to the convention to be held in 1900.

If this is thought advisable by the Association, the committee would recommend the use of a self-registering dynamometer, and that tests should be made on straight track, as well as on a curve, an attachment to be used so as to indicate the lateral motion of the engine on straight track, at maximum speed, with the different tire arrangements.

Square Head Bolts and Nuts: Standards for Pipe Fittings.

Committee—C. H. Quereau, W. H. Marshall, H. Monkhouse.

At a meeting of the American Society of Mechanical Engineers, held in Boston in November, 1885, a committee was appointed by its President to co-operate with the manufacturers of pipe, pipe dies and fittings, with the object of securing uniformity in the sizes and threads, and of maintaining these by the use of standard gauges. Previous to this action of the American Society of Mechanical Engineers, the pipe manufacturers of the United States had nominally adopted the Briggs standard, but a comparison of their products had shown variations which prevented a perfect interchange. A joint meeting of the committee appointed by the American Society of Mechanical Engineers and one appointed by the Manufacturers of Wrought Iron Pipe and Boiler Tubes in the United States was held in New York City, June 17, 1886. At this meeting a motion was carried unanimously "that each manufacturer send to The Pratt & Whitney Co., Hartford, Conn., sample pieces of their pipe from six inches diameter down, threaded on one end, to be tested by the Pratt & Whitney Co. with the Briggs standard, and a report to be made by them to each manufacturer of the state of his gauges only, as compared with the Briggs standard."

As a result, samples were received by The Pratt & Whitney Co. from 14 manufacturing firms.

The gauges used by The Pratt & Whitney Co. were made by them from an autograph copy of a table made by Mr. Robert Briggs personally, who originally established and published

what is known as the Briggs standard wrought iron pipe threads, a copy of which is included in the report.

As a result of the examination of the samples submitted, it was found that the variations from the original standard were such as to warrant the conclusion that the Briggs standard should be maintained. With the exception of the ¾-inch and 1-inch sizes, comparatively little change would be required in any of the dies to accomplish this.

At a meeting of the Manufacturers of Wrought Iron Pipe and Boiler Tubes in the United States, held in Pittsburgh, November 4, 1886, the Briggs standard was endorsed, and also by the Manufacturers' Association of Brass and Iron, Steam, Gas and Water Work, December 15, 1886.

In view of what has preceded, it seems to be well established that it was the intention to adopt the Briggs standard of threads for wrought iron pipes and fittings.

Notwithstanding the action taken, as outlined above, recent investigations made by your committee disclose the fact that so far as the ¾-inch and 1-inch sizes of pipes are concerned, certain manufacturers are still adhering to the standards they had in use in 1886. The variation from the Briggs standard in these sizes of pipes is due to the fact that some makers use a thicker wall by using a larger outside diameter than called for by the Briggs tables, this difference averaging about .03 of an inch. As a consequence the couplings of these thicker pipes are somewhat large for pipes made in accordance with The Pratt & Whitney Briggs standard, and the pipes themselves somewhat large for the couplings made to the Briggs standard.

From the answers received to the circular letter we draw the conclusion that very little trouble is experienced because of lack of uniformity in the threads of wrought iron pipes and couplings; that there is a general understanding that the Briggs table of threads and dimensions is the adopted standard. Out of about sixty replies to this circular we find but eight roads which specify by what templates the Briggs standard shall be tested, and of these eight, six specify The Pratt & Whitney Co. templates. In view of the foregoing facts we recommend the adoption of the Briggs standard, as determined by The Pratt & Whitney Co. gauges, as the standard threads for wrought iron pipe and couplings.

So far as we have been able to determine, there is no universal standard for the threads of wrought iron pipe union nuts, though the sleeves of the unions are quite generally threaded in accordance with the Briggs standard. Because of the great number of standards used by the different manufacturers, the numbers of changes made in the chairmen of the committees, the lack of promptness in receiving promised samples, and several other causes producing unavoidable delays, we are unable to make any recommendation concerning standard threads for wrought iron pipe unions at present. We believe it would be wise if such a general standard could be adopted and would recommend that this portion of the work be continued.

Best Method of Applying Stay Bolts to Locomotive Boilers.

Committee.—T. A. Lawes, G. F. Wilson, S. M. Vauclain.

The general practice is to cut stay bolts off to the required lenght by a concave cutter in a shearing machine. The Pennsylvania Company cuts them off in a turret lathe. The C. C. C. & St. L. Ry. uses a device in which the bolt is held more firmly, while being sheared, than in the ordinary concave shears, and it cuts the ends off squarely. When the concave cutter is used there is more or less tendency for the stay bolt to raise while the shear is cutting, and the result is the end is not cut off squarely.

The usual method of making square heads is by the use of a bolt header. The Buffalo & Susquehanna RR. makes them with dies under a steam hammer; the Chicago, Burlington & Quincy RR. mills off square at end of stay bolt; the Chicago & Northwestern Ry. makes the square with a punch under shears; the C. C. C. & St. L. Ry. does the same, with a special device. Heads can be put on with this device by one man at the rate of 300 per hour. An ordinary bolt header can do this work at the rate of 300 per hour, requiring, however, one man and a helper to operate it. Several members report that they do not square ends. The Chicago & Eastern Illinois RR. has tried headless bolts, but has abandoned their use, for the reason that after screwing them in with an air motor an adjustment must be made by the use of an alligator wrench in order to move the bolt just far enough to properly rivet it. The time used in adjusting and removing the alligator wrench more than balances the cost of forging the square ends.

The Chicago, Milwaukee & St. Paul Ry. report the use of a six-spindle cutting machine—running the bolts through twice; the first time roughing them down very nearly to size and the second time with dies that are in perfect condition—only requiring to straighten up, and cutting but little additional thread. The Delaware & Hudson Canal Company also take two cuts on stay bolts—the second cut being a very light one to finish. A better thread can be obtained by this method, though the usual practice is to take but one cut over a stay bolt. A number of roads report the use of a lead screw attachment an esential to produce stay bolts with threads of accurate pitch.

A large number of roads report the use of ordinary stay bolt taps. A number, however, claim advantages in the use of the "Echols" patent stay bolt tap made by Pratt & Whitney. The principle of this tap is the omission of each alternate tooth; each cutting tooth is followed by a space which gives a freedom of action to the cutting teeth, impossible in the old style, thus decreasing the resistance from 30 to 50 per cent.

In making and applying stay bolts to locomotive boilers, two important factors must be carefully considered: The stay bolt tap and the hob tap which cuts the dies in bolt-cutting machine must be true to pitch, and then the machine must have some special device for making the threads true to pitch. Cutting stay bolts true to pitch is a subject that deserves more investigation, we think, than any other detail connected with making and applying them properly. The weak point in a great many shops is in cutting stay bolts untrue to pitch. It has been found that accurately pitched dies will not produce true-pitched bolts.

Pratt & Whitney write the committee that "the problem of making a tap with long thread and keeping that thread to approximately correct lead has been a very annoying one to us, and doubtless to others, and is still annoying, for the very reason that we cannot rely upon the extent to which steel will change and the manner in which the change will take place. We overcome this very largely, however, by having carefully annealed steel to begin with; having the annealing as uniform as possible, and threading the tap with a screw which is made expressly for the work, and which has an error approximately the error which takes place in the tap in the hardening operation; i. e., long experience teaches us that steel will change in a certain direction. In the great majority of cases this direction is toward the shortening rather than the lengthening. We accordingly make the lead screw of our lathe long, as stated above, to compensate for the shrinkage or shortening that will take place in the steel when hardening. We very often have to give the tool a double shrinkage in very special cases. What we mean by double shrinkage is hardening the tool and reannealing before the final finish, threading on all important taps that have any special length of thread. We confine the error to .0015 per inch or .18 inch per foot."

Correctly cut dies alone will not cut true-pitch stay bolts; to insure stay bolts being cut true to pitch, two methods have been employed: A lead screw attached to the carriage of a bolt-cutter is one way to accomplish this, and the lead-controlling feature employed by the Jones & Lamson Machine Company in the dies used in flat-turret lathe made by them the other.

The Acme Machinery Company writes the committee as follows: "All dies that we have any knowledge of gain threads and lose pitch when cutting threads. Some of our expert die-makers can grind a set of dies so that they can be made to do 'most anything,' but that does not help the 'rank and file,' into whose hands such a machine falls. All kinds of schemes and contrivances have been made and used in trying to correct the disposition of a set of dies to cut out of pitch. Supposing, for instance, the rear teeth of a set of dies would act as a nut; they would certainly begin with an error, because the leading teeth are apt to begin with more or less error, as they 'nibble' at the end of a bolt."

At the New York meeting of the American Society of Mechanical Engineers, in December, 1897, Mr. James Hartness, of Jones & Lamson Co., read a paper on a stay-bolt threading device which has some valuable features, especially for radial stays, where there are threads on both ends of stay bolts and long blank spaces between. (See American Engineer, April, 1898, page 122.) The committee has samples of screw-cutting done by the use of a lead screw on a bolt cutter, and also by the use of a Hartness die. Both methods give equally good results, so far as can be judged by the samples.

The investigations of the committee lead it to believe that the best method of making and applying stay bolts is as follows:

Cut the stay bolts from the bars by means of a shearing machine; make square ends by the use of a bolt-heading machine, or punching the metal from the bar to form a head; cut threads in a bolt cutter, having a lead screw, or on a turret machine having special dies that will cut true to pitch. For a cutting lubricant, lard oil is the best, with yellow cotonseed oil a close second. In preparing the stay-bolt holes, we recommend that: In the fire box, they should be drilled; in the shell of boiler, punched ⅛-inch smaller than required size and the remainder reamed out with a reamer on end of stay-bolt tap. Holes should be tapped with some form of air or electric motor, and stay bolts screwed in with same device. We also recommend that stay-bolt taps, and hob taps for cutting stay-bolt dies, be purchased from some reputable maker in preference to making them at a railroad shop. Stay-bolt and hob tap making requires special skill and most accurate tools, which are not always available at railroad shops. For cutting off stay bolts, no device appears to answer for all bolts. The best practice seems to be as follows: Where bolts are of uniform length, and are at right angles with sheets, as in vertical water space surrounding fire box, it is best to "nick" the bolts in a lathe to the right length; after being screwed into place a slight tap on the end is sufficient to break them off. For bolts that require to be cut off at an angle, an electric saw can be used to advantage; as in cutting or radial stay bolts, outside of boiler. A pneumatic cutting machine can be used to advantage for cutting off bolts of variable lengths after they have been screwed into place, where it would not pay to handle them singly in a lathe or cutting machine. The committee knows of no better way of riveting stay bolts than the well-known method with the common hammer, and a holding-on hammer at the other end of the stay bolt. It is the committee's opinion that some form of air motor for drilling the "detector" holes in stay bolts is preferable to punching them. The objections to punching detector holes is that while stay bolts are being riveted the holes close up and require to be opened with a drift. When the bolt is drilled after it has been riveted there is no further work to be done.